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Confederated Tribes and Bands of the Yakima Indian Nation

Established by the Treaty of June 9, 1855

January 18, 1995

Mr. Chuck Clarke
Region 10 Administrator
U. S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

Mr. John Wagoner, Manager
Richland Field Office
Department of Energy
P.O. Box 550 A7-50
Richland, WA 99352

FEB 1995 RECEIVED

Dear Mr. Clarke and Mr. Wagoner:

Subject: HANFORD ENVIRONMENTAL REMEDIATION DISPOSAL FACILITY (ERDF); PENDING DECISION ON DESIGN ALTERNATIVES; DISAGREEMENT WITH ALTERNATIVE THAT RESTRICTS HUMAN ACTIONS AT THE SITE FOREVER; REQUEST TO SPECIFY ALTERNATIVE THAT LIMITS RESTRICTIONS TO NO MORE THAN 100 YEARS PAST SITE CLOSURE--

It recently came to our attention during a natural resource trustee meeting regarding Hanford cleanup actions that the Environmental Protection Agency Region 10 and the Department of Energy were near a decision on the subject disposal facility design.

We note that environmental impact evaluations relative to the proposed actions do not take into account activities of Yakama Nation members in the future. Evaluation scenarios have not reflected comments from the Yakama Nation relative to this project and other Hanford projects and verbal comments from Yakama Nation technical representatives in numerous meetings with EPA and Department of Energy personnel participating in the design of this project. In particular our disagreement with the concept requiring permanent restrictions at the proposed site, meaning reliance on permanent institutional controls to protect the health of future generations and the ecological system, has been voiced in numerous meetings and documented in letters regarding design criteria for such disposal facilities.

An example of such documentation was our letter to EPA with a copy to DOE/RL, Mr. Wagoner, of December 21, 1993 regarding principles, standards and design criteria for environmental restoration and waste management actions. Our comments are enclosed as Attachment A.

During the initial scoping of alternatives for the subject disposal facility early last year, about the same time we forwarded Attachment A, we made a request to DOE and EPA representatives that a standard environmental impact statement be prepared to assure evaluation of all

HANFORD PROJECT OFFICE
JAN 25 1995
ENVIRONMENTAL PROTECTION AGENCY

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environmental impacts relative to Yakama Nation values and actions of future generations. We do not consider that the evaluation process that has occurred properly reflects these values and identifies impacts.

In particular impacts associated with the permanent restricted access being considered, the "sacrifice zone" concept which is the basis for the current design, are unacceptable. We consider the ERDF may infringe upon freedom to utilize the lands and waters for subsistence of our people in the future and may cause restrictions inconsistent with Treaty provisions. In addition we consider the basis which assumes the existence of institutional controls to restrict actions of future generations is highly unreliable and insufficient to avoid health impacts and further contamination of the general vicinity in the distant future as contemplated engineered barriers disintegrate and are otherwise disrupted by human actions or natural occurrences.

Such concerns reflecting uncertainty in the ability of society to control activities of future generations and to predict natural occurrences has led to the decision to dispose of permanent (long-lived) nuclear wastes in deep geologic repositories to assure the protection of future generations without dependence upon institutional controls.

Actions being considered to permit the subject facility at Hanford contradict these previous determinations (National Policy) regarding disposal of permanently hazardous radioactive materials. We consider such criteria unwise and unethical with respect to assuring the well being of future generations and protection/remediation of our natural environment.

REQUEST FOR ACTION:

We request that you specify ERDF design criteria equivalent to, or more protective than, those described in Attachment A. If permanent commitment of resources, including permanent institutional controls are considered warranted, EPA should assure that an appropriate National Environmental Policy Act process is accomplished and allowances are made to provide for legal challenge to the decisions stemming from the NEPA evaluation consistent with provisions of that law. Such NEPA evaluation should clearly consider impacts on Treaty obligations of the United States and whether or not actions are warranted.

We do not know of any valid evaluation having been made to date with respect to an ERDF design requiring permanent institutional control.

ALTERNATIVE ACTIONS TO CONSIDER:

Robust surface storage vaults for wastes for which remediation technology is not available should be considered. Such a facility should use materials that are recovered during remediation to provide safe interim storage for long-lived radioactive or chemically hazardous

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materials. Actions being planned should not make it harder for future generations to permanently remediate hazardous materials. Facility designs should anticipate such future remediation pending technology development and store wastes to facilitate such remediation.

Thus, large portions of concrete debris should be recycled. Metal waste should be recovered and recycled in unrestricted raw material applications or in contaminated waste package or shield applications. Such metallic waste packages and shields should be designed to incorporate heavy metals which are not otherwise recoverable.

Organic hazards should be destroyed. Short-lived radioactive materials should be held for decay or disposed in an ERDF meeting the 100 year unrestricted use criteria. Long-lived radioactive materials which cannot be recycled should be incorporated into waste streams slated for deep geologic isolation.

We note that there are waste management companies that have such alternative planning and facility conceptual designs at hand. In addition they are willing to participate in such recycling and interim storage of wastes at Hanford, pending development of technologies to further separate for disposal or recycle long-lived radio isotopes and undesirable heavy metals. Methods for destruction of hazardous organic materials are well known and ready for implementation by various waste management companies.

We urge your positive consideration of these alternatives to avoid excessive delays, attendant costs and, most of all, inadequate environmental stewardship.

Sincerely,

Russell Jim, Manager
Environmental Restoration/Waste Management Program
Yakama Indian Nation

ATTACHMENT: YIN letter of December 21, 1993 to EPA.

cc: K. Clarke, DOE/RL
M. Riveland, WA Ecol.
T. Grumbly, DOE/EM
T. O'Toole, DOE/EH
Washington Gov. M. Lowry
U. S. Senator P. Murray
DNFSB
EPA Administrator, Washington, D.C.
Dennis Faulk, USEPA, Richland

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Table 5.2A-2. Constituents with at Least One Detected Value for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (21 sheets)

Well Name	Collection Date	Sample Number	NICKEL 34/ppb 16/.	FNICKEL 34/ppb 16/.	NITRATE 124/ppb 96/45000	POTASUM 34/ppb 890/.
699-24-33	9/14/94	B0CBL2		16.00 U		
699-24-33	9/14/94	B0CBL3		16.00 U		
699-24-34A	11/03/93	B09JN7			14000.00 D	
699-24-34A	11/03/93	B09JP1		17.90 U		
699-24-34A	2/10/94	B0B053			13000.00 D	
699-24-34A	2/10/94	B0B057		17.90 U		
699-24-34A	6/06/94	B0BY22			14000.00 D	
699-24-34A	6/06/94	B0BY26		16.00 U		
699-24-34A	9/14/94	B0CBL8		16.00 U		
699-24-34B	11/03/93	B09JP2			17000.00 D	
699-24-34B	11/03/93	B09JP6		17.90 U		
699-24-34B	2/10/94	B0B058			16000.00 D	
699-24-34B	2/10/94	B0B062		17.90 U		
699-24-34B	6/06/94	B0BY27			17000.00 D	
699-24-34B	6/06/94	B0BY31		16.00 U		
699-24-34B	8/25/94	B0CBL9			18000.00 D	
699-24-34B	8/25/94	B0CBM3		16.00 U		
699-24-34C	11/03/93	B09JP7			26000.00 D	
699-24-34C	11/03/93	B09JQ1		17.90 U		
699-24-34C	2/14/94	B0B063			26000.00 D	
699-24-34C	2/14/94	B0B067		17.90 U		
699-24-34C	6/01/94	B0BY32			23000.00 D	
699-24-34C	6/01/94	B0BY36		16.00 U		
699-24-34C	8/25/94	B0CBM4			23000.00 D	
699-24-34C	8/25/94	B0CBM8		16.00 U		
699-24-35	11/03/93	B09JQ2			12000.00 D	
699-24-35	11/03/93	B09JQ6		17.90 U		
699-24-35	2/10/94	B0B068			11000.00 D	
699-24-35	2/10/94	B0B072		17.90 U		
699-24-35	6/01/94	B0BY37			12000.00 D	
699-24-35	6/01/94	B0BY38			12000.00 D	
699-24-35	6/01/94	B0BY45		16.00 U		
699-24-35	6/01/94	B0BY46		16.00 U		
699-24-35	8/25/94	B0CBN3			13000.00 D	
699-24-35	8/25/94	B0CBN7		18.00 L		
699-25-34C	11/03/93	B09JQ7			27000.00 D	
699-25-34C	11/03/93	B09JR1		17.90 U		
699-25-34C	2/22/94	B0B073			24000.00 D	
699-25-34C	2/22/94	B0B077		17.90 U		
699-25-34C	6/21/94	B0BY47			28000.00 D	
699-25-34C	6/21/94	B0BY51		430.00		
699-25-34C	8/25/94	B0CBN8			27000.00 D	
699-25-34C	8/25/94	B0CBP2		16.00 U		
699-26-35A	11/03/93	B09JR2			28000.00 D	
699-26-35A	11/03/93	B09JR6		17.90 U		
699-26-35A	2/03/94	B09ZT1	17.90 U			6700.00 B
699-26-35A	2/03/94	B0B078			25000.00 D	
699-26-35A	2/03/94	B0B082		17.90 U		
699-26-35A	6/01/94	B0BY52			27000.00 D	
699-26-35A	6/01/94	B0BY56		16.00 U		
699-26-35A	8/17/94	B0CBG9			27000.00 D	
699-26-35A	8/17/94	B0CBH3		16.00 U		

Table 5.2A-2. Constituents with at Least One Detected Value for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (21 sheets)

Well Name	Collection Date	Sample Number	FPOTASS 34/ppb 890/.	SODIUM 34/ppb 150/.	FSODIUM 34/ppb 150/.	SULFATE 124/ppb 89/250000s
699-22-35	2/22/94	B0B039				49000.00 DQ
699-22-35	2/22/94	B0B040	9100.00 B		25000.00 B	
699-22-35	6/07/94	B0BY02				52000.00 D
699-22-35	6/07/94	B0BY06	7600.00		23000.00	
699-22-35	8/31/94	B0CBH9				53000.00 D
699-22-35	8/31/94	B0CBJ3	8900.00		24000.00 Q	
699-23-34A	12/06/93	B09M30				46000.00 D
699-23-34A	12/06/93	B09M34	8200.00		24000.00 Q	
699-23-34A	2/10/94	B0B041				73000.00 DF
699-23-34A	2/10/94	B0B045	7600.00		23000.00 BQ	
699-23-34A	6/06/94	B0BY07				47000.00 D
699-23-34A	6/06/94	B0BY11	7100.00		22000.00	
699-23-34A	8/25/94	B0CBJ4				47000.00 D
699-23-34A	8/25/94	B0CBJ8	7400.00		21000.00	
699-23-34B	2/22/94	B0B046				48000.00 DQ
699-23-34B	2/22/94	B0B047	8700.00 B		24000.00 B	
699-23-34B	6/02/94	B0BY12				52000.00 D
699-23-34B	6/02/94	B0BY16	8000.00		22000.00	
699-23-34B	8/31/94	B0CBJ9				51000.00 D
699-23-34B	8/31/94	B0CBK3	8300.00		23000.00 Q	
699-24-33	11/03/93	B09JN2				43000.00 D
699-24-33	11/03/93	B09JN6	8000.00		25000.00	
699-24-33	2/14/94	B0B048				46000.00 DQ
699-24-33	2/14/94	B0B052	7900.00		23000.00	
699-24-33	6/06/94	B0BY17				45000.00 D
699-24-33	6/06/94	B0BY21	7100.00		22000.00	
699-24-33	9/14/94	B0CBL2	7400.00		23000.00 Q	
699-24-33	9/14/94	B0CBL3	7200.00		22000.00 Q	
699-24-34A	11/03/93	B09JN7				46000.00 D
699-24-34A	11/03/93	B09JP1	7700.00		24000.00	
699-24-34A	2/10/94	B0B053				45000.00 D
699-24-34A	2/10/94	B0B057	7600.00		23000.00 BQ	
699-24-34A	6/06/94	B0BY22				48000.00 D
699-24-34A	6/06/94	B0BY26	6500.00		21000.00	
699-24-34A	9/14/94	B0CBL8	7200.00		22000.00 Q	
699-24-34B	11/03/93	B09JP2				46000.00 D
699-24-34B	11/03/93	B09JP6	7800.00		24000.00	
699-24-34B	2/10/94	B0B058				44000.00 D
699-24-34B	2/10/94	B0B062	7500.00		23000.00 BQ	
699-24-34B	6/06/94	B0BY27				46000.00 D
699-24-34B	6/06/94	B0BY31	7200.00		21000.00	
699-24-34B	8/25/94	B0CBL9				46000.00 D
699-24-34B	8/25/94	B0CBM3	7300.00		22000.00	
699-24-34C	11/03/93	B09JP7				44000.00 D
699-24-34C	11/03/93	B09JQ1	7800.00		25000.00	
699-24-34C	2/14/94	B0B063				47000.00 DQ
699-24-34C	2/14/94	B0B067	7900.00		24000.00	
699-24-34C	6/01/94	B0BY32				44000.00 D
699-24-34C	6/01/94	B0BY36	8100.00		24000.00	
699-24-34C	8/25/94	B0CBM4				45000.00 D
699-24-34C	8/25/94	B0CBM8	7400.00		23000.00	
699-24-35	11/03/93	B09JQ2				46000.00 D
699-24-35	11/03/93	B09JQ6	7300.00		23000.00	
699-24-35	2/10/94	B0B068				44000.00 D
699-24-35	2/10/94	B0B072	7400.00		23000.00 BQ	
699-24-35	6/01/94	B0BY37				46000.00 D
699-24-35	6/01/94	B0BY38				46000.00 D

Table 5.2A-2. Constituents with at Least One Detected Value for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (21 sheets)

Well Name	Collection Date	Sample Number	FPOTASS 34/ppb 890/.	SODIUM 34/ppb 150/.	FSODIUM 34/ppb 150/.	SULFATE 124/ppb 89/250000s
699-24-35	6/01/94	B0BY45	7900.00		23000.00	
699-24-35	6/01/94	B0BY46	7700.00		23000.00	
699-24-35	8/25/94	B0CBN3				46000.00 D
699-24-35	8/25/94	B0CBN7	7100.00		21000.00	
699-25-34C	11/03/93	B09JQ7				41000.00 D
699-25-34C	11/03/93	B09JR1	7000.00		24000.00	
699-25-34C	2/22/94	B0B073				40000.00 DQ
699-25-34C	2/22/94	B0B077	7200.00 Q		23000.00 BQ	
699-25-34C	6/21/94	B0BY47				51000.00 D
699-25-34C	6/21/94	B0BY51	7400.00		25000.00	
699-25-34C	8/25/94	B0CBN8				42000.00 D
699-25-34C	8/25/94	B0CBP2	6600.00		22000.00	
699-26-35A	11/03/93	B09JR2				41000.00 D
699-26-35A	11/03/93	B09JR6	6100.00		24000.00	
699-26-35A	2/03/94	B09ZT1		23000.00 BQ		
699-26-35A	2/03/94	B0B078				38000.00 D
699-26-35A	2/03/94	B0B082	6900.00 B		22000.00 BQ	
699-26-35A	6/01/94	B0BY52				43000.00 D
699-26-35A	6/01/94	B0BY56	6900.00		24000.00	
699-26-35A	8/17/94	B0CBG9				40000.00 D
699-26-35A	8/17/94	B0CBH3	5900.00		23000.00 B	

Well Name	Collection Date	Sample Number	TMP_C 170/DegC .1/.	PERCENE 25/ppb .08/5	TIN 34/ppb 24/.	FTIN 34/ppb 24/.
699-22-35	2/22/94	B0B039	17.30	2.30		
699-22-35	2/22/94	B0B040				51.10 U
699-22-35	6/07/94	B0BY02	18.30	2.70		
699-22-35	6/07/94	B0BY03	18.40			
699-22-35	6/07/94	B0BY04	18.40			
699-22-35	6/07/94	B0BY05	18.40			
699-22-35	6/07/94	B0BY06				26.00 BLQ
699-22-35	8/31/94	B0CBH9	19.60	1.90		
699-22-35	8/31/94	B0CBJ0	19.60			
699-22-35	8/31/94	B0CBJ1	19.60			
699-22-35	8/31/94	B0CBJ2	19.60			
699-22-35	8/31/94	B0CBJ3				28.00 LB
699-23-34A	12/06/93	B09M30	17.80	4.30		
699-23-34A	12/06/93	B09M31	17.80			
699-23-34A	12/06/93	B09M32	17.80			
699-23-34A	12/06/93	B09M33	17.80			
699-23-34A	12/06/93	B09M34				51.10 U
699-23-34A	2/10/94	B0B041	17.70	4.10		
699-23-34A	2/10/94	B0B042	17.70			
699-23-34A	2/10/94	B0B043	17.70			
699-23-34A	2/10/94	B0B044	17.70			
699-23-34A	2/10/94	B0B045				51.10 U
699-23-34A	6/06/94	B0BY07	18.30	4.10		
699-23-34A	6/06/94	B0BY08	18.40			
699-23-34A	6/06/94	B0BY09	18.40			
699-23-34A	6/06/94	B0BY10	18.40			
699-23-34A	6/06/94	B0BY11				69.00 LQ
699-23-34A	8/25/94	B0CBJ4	18.70	3.40		
699-23-34A	8/25/94	B0CBJ8				24.00 U

Table 5.2A-2. Constituents with at Least One Detected Value for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (21 sheets)

Well Name	Collection Date	Sample Number	TMP_C 170/DegC .1/.	PERCENE 25/ppb .08/5	TIN 34/ppb 24/.	FTIN 34/ppb 24/.
699-23-34B	2/22/94	B0B046	17.60	3.30		
699-23-34B	2/22/94	B0B047				51.10 U
699-23-34B	6/02/94	B0BY12	18.00	3.30		
699-23-34B	6/02/94	B0BY13	18.00			
699-23-34B	6/02/94	B0BY14	18.00			
699-23-34B	6/02/94	B0BY15	18.00			
699-23-34B	6/02/94	B0BY16				88.00 LQ
699-23-34B	8/31/94	B0CBJ9	19.00	3.20		
699-23-34B	8/31/94	B0CBK0	19.00			
699-23-34B	8/31/94	B0CBK1	19.00			
699-23-34B	8/31/94	B0CBK2	19.00			
699-23-34B	8/31/94	B0CBK3				33.00 LB
699-24-33	11/03/93	B09JN2	19.30	4.10 B		
699-24-33	11/03/93	B09JN3	19.30			
699-24-33	11/03/93	B09JN4	19.30			
699-24-33	11/03/93	B09JN5	19.30			
699-24-33	11/03/93	B09JN6				51.10 U
699-24-33	2/14/94	B0B048	19.10	3.00		
699-24-33	2/14/94	B0B049	19.20			
699-24-33	2/14/94	B0B050	19.20			
699-24-33	2/14/94	B0B051	19.20			
699-24-33	2/14/94	B0B052				51.10 U
699-24-33	6/06/94	B0BY17	19.80	3.00		
699-24-33	6/06/94	B0BY18	19.80			
699-24-33	6/06/94	B0BY19	19.80			
699-24-33	6/06/94	B0BY20	19.80			
699-24-33	6/06/94	B0BY21				32.00 LQ
699-24-33	9/14/94	B0CBK4	20.10	3.00		
699-24-33	9/14/94	B0CBK5	20.10	3.00		
699-24-33	9/14/94	B0CBK6	20.10			
699-24-33	9/14/94	B0CBK7	20.10			
699-24-33	9/14/94	B0CBL2				24.00 U
699-24-33	9/14/94	B0CBL3				24.00 U
699-24-34A	11/03/93	B09JN7	18.10	4.50 B		
699-24-34A	11/03/93	B09JN8	18.10			
699-24-34A	11/03/93	B09JN9	18.10			
699-24-34A	11/03/93	B09JP0	18.10			
699-24-34A	11/03/93	B09JP1				51.10 U
699-24-34A	2/10/94	B0B053	18.10	3.80		
699-24-34A	2/10/94	B0B054	18.10			
699-24-34A	2/10/94	B0B055	18.10			
699-24-34A	2/10/94	B0B056	18.10			
699-24-34A	2/10/94	B0B057				51.10 U
699-24-34A	6/06/94	B0BY22	18.50	3.80		
699-24-34A	6/06/94	B0BY26				44.00 LQ
699-24-34A	9/14/94	B0CBL4	19.00	3.00		
699-24-34A	9/14/94	B0CBL5	19.00			
699-24-34A	9/14/94	B0CBL6	19.00			
699-24-34A	9/14/94	B0CBL7	19.00			
699-24-34A	9/14/94	B0CBL8				24.00 U
699-24-34B	11/03/93	B09JP2	18.40	5.10 B		
699-24-34B	11/03/93	B09JP3	18.40			
699-24-34B	11/03/93	B09JP4	18.40			
699-24-34B	11/03/93	B09JP5	18.50			
699-24-34B	11/03/93	B09JP6				51.10 U
699-24-34B	2/10/94	B0B058	17.90	4.20		
699-24-34B	2/10/94	B0B062				51.10 U

Table 5.2A-2. Constituents with at Least One Detected Value for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (21 sheets)

Well Name	Collection Date	Sample Number	TMP_C 170/DegC .1/.	PERCENE 25/ppb .08/5	TIN 34/ppb 24/.	FTIN 34/ppb 24/.
699-24-34B	6/06/94	B0BY27	19.00	4.40		
699-24-34B	6/06/94	B0BY31				50.00 LQ
699-24-34B	8/25/94	B0CBL9	19.40	3.80		
699-24-34B	8/25/94	B0CBM3				24.00 U
699-24-34C	11/03/93	B09JP7	19.30	6.50 B		
699-24-34C	11/03/93	B09JQ1				51.10 U
699-24-34C	2/14/94	B0B063	18.40	4.70		
699-24-34C	2/14/94	B0B064	18.40			
699-24-34C	2/14/94	B0B065	18.40			
699-24-34C	2/14/94	B0B066	18.40			
699-24-34C	2/14/94	B0B067				51.10 U
699-24-34C	6/01/94	B0BY32	19.30	4.90		
699-24-34C	6/01/94	B0BY36				24.00 U
699-24-34C	8/25/94	B0CBM4	19.00	4.50		
699-24-34C	8/25/94	B0CBM8				24.00 U
699-24-35	11/03/93	B09JQ2	18.50	1.10 B		
699-24-35	11/03/93	B09JQ6				51.10 U
699-24-35	2/10/94	B0B068	17.50	.71		
699-24-35	2/10/94	B0B072				51.10 U
699-24-35	6/01/94	B0BY37	19.10	1.10 Q		
699-24-35	6/01/94	B0BY38		1.50 Q		
699-24-35	6/01/94	B0BY45				24.00 UQ
699-24-35	6/01/94	B0BY46				37.00 LQ
699-24-35	8/25/94	B0CBN3	18.80	.99		
699-24-35	8/25/94	B0CBN7				24.00 U
699-25-34C	11/03/93	B09JQ7	19.80	2.00 B		
699-25-34C	11/03/93	B09JR1				51.10 U
699-25-34C	2/22/94	B0B073	18.50	1.40		
699-25-34C	2/22/94	B0B074	18.70			
699-25-34C	2/22/94	B0B075	18.70			
699-25-34C	2/22/94	B0B076	18.70			
699-25-34C	2/22/94	B0B077				51.10 U
699-25-34C	6/21/94	B0BY47	19.50	1.70		
699-25-34C	6/21/94	B0BY48	19.50			
699-25-34C	6/21/94	B0BY49	19.50			
699-25-34C	6/21/94	B0BY50	19.50			
699-25-34C	6/21/94	B0BY51				24.00 U
699-25-34C	8/25/94	B0CBN8	19.80	1.50		
699-25-34C	8/25/94	B0CBP2				24.00 U
699-26-35A	11/03/93	B09JR2	20.20	.53 B		
699-26-35A	11/03/93	B09JR6				51.10 U
699-26-35A	2/03/94	B09ZT1			51.10 U	
699-26-35A	2/03/94	B0B078	19.00	.44 L		
699-26-35A	2/03/94	B0B082				51.10 U
699-26-35A	6/01/94	B0BY52	19.40	.95		
699-26-35A	6/01/94	B0BY56				24.00 U
699-26-35A	8/17/94	B0CBG9	20.10	.44 L		
699-26-35A	8/17/94	B0CBH3				24.00 U

Table 5.2A-2. Constituents with at Least One Detected Value for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (21 sheets)

Well Name	Collection Date	Sample Number	TOLUENE 25/ppb .077/1000	TC 127/ppb 320/.	TDS 65/ppm 10/500s	TRICENE 25/ppb .043/5
699-22-35	2/22/94	B0B039	.06 U	81000.00 BQ	480.00	4.30
699-22-35	6/07/94	B0BY02	.08 U	89000.00	440.00	2.50
699-22-35	8/31/94	B0CBH9	.17 L	85000.00	460.00	2.20
699-23-34A	12/06/93	B09M30	.06 U	80000.00 BQ	400.00	2.50
699-23-34A	2/10/94	B0B041	.06 U	70000.00 BQ	440.00	2.20 B
699-23-34A	6/06/94	B0BY07	.08 U	81000.00	410.00	2.20
699-23-34A	8/25/94	B0CBJ4	.08 U	66000.00	410.00	2.30
699-23-34B	2/22/94	B0B046	.06 U	78000.00 BQ	450.00	2.60
699-23-34B	6/02/94	B0BY12	.08 U	97000.00	460.00	2.20
699-23-34B	8/31/94	B0CBJ9	.08 U	77000.00	450.00	2.00
699-24-33	11/03/93	B09JN2	.06 BL	69000.00 B	400.00	1.50
699-24-33	2/14/94	B0B048	.06 U	67000.00 BQ	410.00	1.10 B
699-24-33	6/06/94	B0BY17	.08 U	74000.00	400.00	1.10
699-24-33	9/14/94	B0CBK4	.08 U	71000.00 B	- -	.96 L
699-24-33	9/14/94	B0CBK5	.08 U	71000.00 B		1.20
699-24-34A	11/03/93	B09JN7	.06 BL	66000.00 B	370.00	2.30
699-24-34A	2/10/94	B0B053	.06 U	64000.00 BQ	390.00	1.90 B
699-24-34A	6/06/94	B0BY22	.08 U	78000.00	380.00	1.80
699-24-34A	9/14/94	B0CBL4	.08 U	71000.00 B		1.70
699-24-34B	11/03/93	B09JP2	.06 BL	71000.00 B	380.00	2.00
699-24-34B	2/10/94	B0B058	.06 U	65000.00 BQ	390.00	1.80 B
699-24-34B	6/06/94	B0BY27	.08 U	78000.00	390.00	1.60
699-24-34B	8/25/94	B0CBL9	.08 U	65000.00	390.00	1.80
699-24-34C	11/03/93	B09JP7	.06 U	97000.00 B	440.00	2.10
699-24-34C	2/14/94	B0B063	.06 U	74000.00 BQ	430.00	1.30 B
699-24-34C	6/01/94	B0BY32	.08 U	79000.00	440.00	1.70
699-24-34C	8/25/94	B0CBM4	.08 U	75000.00	440.00	1.70
699-24-35	11/03/93	B09JQ2	.06 U	51000.00 B	310.00	.34 L
699-24-35	2/10/94	B0B068	.06 U	49000.00 BQ	320.00	.11 BL
699-24-35	6/01/94	B0BY37	.08 U	53000.00	340.00	.08 LQ
699-24-35	6/01/94	B0BY38	.08 U	56000.00	330.00	.17 LQ
699-24-35	8/25/94	B0CBN3	.08 U	45000.00	330.00	.30 L
699-25-34C	11/03/93	B09JQ7	.06 U	56000.00 B	340.00	.90 L
699-25-34C	2/22/94	B0B073	.06 U	43000.00 BQ	350.00	.94 L
699-25-34C	6/21/94	B0BY47	.08 U	49000.00	380.00	.35 L
699-25-34C	8/25/94	B0CBN8	.08 U	47000.00	360.00	.78 L
699-26-35A	11/03/93	B09JR2	.06 U	39000.00 B	280.00	.31 L
699-26-35A	2/03/94	B0B078	.06 U	39000.00 BQ	280.00 B	.21 L
699-26-35A	6/01/94	B0BY52	.08 U	40000.00	280.00	.14 L
699-26-35A	8/17/94	B0CBG9	.08 U	36000.00	300.00	.19 L

Table 5.2A-2. Constituents with at Least One Detected Value for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (21 sheets)

Well Name	Collection Date	Sample Number	TRITIUM 142/pCi/L ./20000	TURBID 126/NTU .016/.	VANADUM 34/ppb 6.4/.	FVANADI 34/ppb 6.4/.
699-22-35	2/22/94	B0B039	104.00 U	25.00 Q		
699-22-35	2/22/94	B0B040				7.00 L
699-22-35	6/07/94	B0BY02	210.00 U	3.10 Q		
699-22-35	6/07/94	B0BY06				8.40 L
699-22-35	8/31/94	B0CBH9	280.00 U	19.00 Q		
699-22-35	8/31/94	B0CBJ3				9.40 L
699-23-34A	12/06/93	B09M30	15500.00	.60		
699-23-34A	12/06/93	B09M34				10.00 L
699-23-34A	2/10/94	B0B041	14500.00	.29		
699-23-34A	2/10/94	B0B045				12.00 L
699-23-34A	6/06/94	B0BY07	12500.00	2.50 Q		
699-23-34A	6/06/94	B0BY11				8.30 L
699-23-34A	8/25/94	B0CBJ4	15900.00	.55 Q		
699-23-34A	8/25/94	B0CBJ8				9.00 L
699-23-34B	2/22/94	B0B046	390.00	42.00 Q		
699-23-34B	2/22/94	B0B047				10.00 L
699-23-34B	6/02/94	B0BY12	480.00	13.00		
699-23-34B	6/02/94	B0BY16				11.00 L
699-23-34B	8/31/94	B0CBJ9	63.90 U	6.40 Q		
699-23-34B	8/31/94	B0CBK3				8.30 L
699-24-33	11/03/93	B09JN2	167000.00			
699-24-33	11/03/93	B09JN6				19.00 L
699-24-33	2/14/94	B0B048	151000.00	.28 Q		
699-24-33	2/14/94	B0B052				13.00 L
699-24-33	6/06/94	B0BY17	134000.00	.32 Q		
699-24-33	6/06/94	B0BY21				12.00 L
699-24-33	9/14/94	B0CBK4	119000.00	.17 Q		
699-24-33	9/14/94	B0CBK5	119000.00	.31 Q		
699-24-33	9/14/94	B0CBL2				13.00 L
699-24-33	9/14/94	B0CBL3				13.00 L
699-24-34A	11/03/93	B09JN7	36100.00			
699-24-34A	11/03/93	B09JP1				18.00 L
699-24-34A	2/10/94	B0B053	29900.00	2.40		
699-24-34A	2/10/94	B0B057				12.00 L
699-24-34A	6/06/94	B0BY22	26800.00	7.50 Q		
699-24-34A	6/06/94	B0BY26				8.30 L
699-24-34A	9/14/94	B0CBL4	31800.00	3.00 Q		
699-24-34A	9/14/94	B0CBL8				10.00 L
699-24-34B	11/03/93	B09JP2	72000.00			
699-24-34B	11/03/93	B09JP6				19.00 L
699-24-34B	2/10/94	B0B058	61200.00	.70		
699-24-34B	2/10/94	B0B062				15.00 L
699-24-34B	6/06/94	B0BY27	61600.00	1.00 Q		
699-24-34B	6/06/94	B0BY31				13.00 L
699-24-34B	8/25/94	B0CBL9	69500.00	2.90 Q		
699-24-34B	8/25/94	B0CBM3				12.00 L
699-24-34C	11/03/93	B09JP7	170000.00			
699-24-34C	11/03/93	B09JQ1				16.00 L
699-24-34C	2/14/94	B0B063	153000.00	6.50 Q		
699-24-34C	2/14/94	B0B067				9.90 L
699-24-34C	6/01/94	B0BY32	134000.00	6.40		
699-24-34C	6/01/94	B0BY36				12.00 L
699-24-34C	8/25/94	B0CBM4	129000.00	1.70 Q		
699-24-34C	8/25/94	B0CBM8				11.00 L
699-24-35	11/03/93	B09JQ2	14100.00			
699-24-35	11/03/93	B09JQ6				17.00 L
699-24-35	2/10/94	B0B068	12200.00	2.00		
699-24-35	2/10/94	B0B072				15.00 L

Table 5.2A-2. Constituents with at Least One Detected Value for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (21 sheets)

Well Name	Collection Date	Sample Number	TRITIUM 142/pCi/L ./20000	TURBID 126/NTU .016/.	VANADUM 34/ppb 6.4/.	FVANADI 34/ppb 6.4/.
699-24-35	6/01/94	B0BY37	11300.00	2.90		
699-24-35	6/01/94	B0BY38	11500.00	2.90		
699-24-35	6/01/94	B0BY45				12.00 L
699-24-35	6/01/94	B0BY46				13.00 L
699-24-35	8/25/94	B0CBN3	14200.00	3.10 Q		
699-24-35	8/25/94	B0CBN7				14.00 L
699-25-34C	11/03/93	B09JQ7	214000.00			
699-25-34C	11/03/93	B09JR1				17.00 L
699-25-34C	2/22/94	B0B073	195000.00	.51 Q		
699-25-34C	2/22/94	B0B077				16.00 L
699-25-34C	6/21/94	B0BY47	186000.00	4.40		
699-25-34C	6/21/94	B0BY51				12.00 L
699-25-34C	8/25/94	B0CBN8	181000.00	.45 Q		
699-25-34C	8/25/94	B0CBP2				15.00 L
699-26-35A	11/03/93	B09JR2	218000.00			
699-26-35A	11/03/93	B09JR6				24.00 L
699-26-35A	2/03/94	B09ZT1			21.00 L	
699-26-35A	2/03/94	B0B078	211000.00	.23 Q		
699-26-35A	2/03/94	B0B082				24.00 L
699-26-35A	6/01/94	B0BY52	198000.00	.19		
699-26-35A	6/01/94	B0BY56				18.00 L
699-26-35A	8/17/94	B0CBG9	188000.00	.38		
699-26-35A	8/17/94	B0CBH3				17.00 L

Well Name	Collection Date	Sample Number	XYLENE 25/ppb .2/10000	ZINC 34/ppb 4.4/5000s	FZINC 34/ppb 4.4/5000s	CIS12DE 25/ppb .045/70
699-22-35	2/22/94	B0B039	.20 U			.13 U
699-22-35	2/22/94	B0B040			12.00 B	
699-22-35	6/07/94	B0BY02	.20 U			.05 U
699-22-35	6/07/94	B0BY06			8.50 L	
699-22-35	8/31/94	B0CBH9	.44 L			.05 L
699-22-35	8/31/94	B0CBJ3			4.40 U	
699-23-34A	12/06/93	B09M30	.20 U			.13 U
699-23-34A	12/06/93	B09M34			11.00 Q	
699-23-34A	2/10/94	B0B041	.20 U			.13 U
699-23-34A	2/10/94	B0B045			4.30 BLQ	
699-23-34A	6/06/94	B0BY07	.20 U			.05 U
699-23-34A	6/06/94	B0BY11			4.40 U	
699-23-34A	8/25/94	B0CBJ4	.20 U			.05 U
699-23-34A	8/25/94	B0CBJ8			7.70 LB	
699-23-34B	2/22/94	B0B046	.20 U			.13 U
699-23-34B	2/22/94	B0B047			11.00 B	
699-23-34B	6/02/94	B0BY12	.20 U			.05 U
699-23-34B	6/02/94	B0BY16			4.40 U	
699-23-34B	8/31/94	B0CBJ9	.20 U			.05 U
699-23-34B	8/31/94	B0CBK3			4.40 U	
699-24-33	11/03/93	B09JN2	.20 U			.13 U
699-24-33	11/03/93	B09JN6			16.00	
699-24-33	2/14/94	B0B048	.20 U			.13 U
699-24-33	2/14/94	B0B052			10.00 B	
699-24-33	6/06/94	B0BY17	.20 U			.05 U
699-24-33	6/06/94	B0BY21			12.00	
699-24-33	9/14/94	B0CBK4	.20 U			.05 U
699-24-33	9/14/94	B0CBK5	.20 U			.05 U

Table 5.2A-2. Constituents with at Least One Detected Value for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (21 sheets)

Well Name	Collection Date	Sample Number	XYLENE 25/ppb .2/10000	ZINC 34/ppb 4.4/5000s	FZINC 34/ppb 4.4/5000s	CIS12DE 25/ppb .045/70
699-24-33	9/14/94	B0CBL2			15.00 BQ	
699-24-33	9/14/94	B0CBL3			11.00 BQ	
699-24-34A	11/03/93	B09JN7	.22 BL			.43 L
699-24-34A	11/03/93	B09JP1			13.00	
699-24-34A	2/10/94	B0B053	.20 U			.13 U
699-24-34A	2/10/94	B0B057			6.80 BLQ	
699-24-34A	6/06/94	B0BY22	.20 U			.10 L
699-24-34A	6/06/94	B0BY26			4.40 U	
699-24-34A	9/14/94	B0CBL4	.20 U			.19 L
699-24-34A	9/14/94	B0CBL8			4.40 U	
699-24-34B	11/03/93	B09JP2	.20 U			.15 L
699-24-34B	11/03/93	B09JP6			14.00	
699-24-34B	2/10/94	B0B058	.20 U			.13 U
699-24-34B	2/10/94	B0B062			8.70 BLQ	
699-24-34B	6/06/94	B0BY27	.20 U			.07 L
699-24-34B	6/06/94	B0BY31			4.40 U	
699-24-34B	8/25/94	B0CBL9	.20 U			.06 L
699-24-34B	8/25/94	B0CBM3			11.00 B	
699-24-34C	11/03/93	B09JP7	.20 U			.24 L
699-24-34C	11/03/93	B09JQ1			7.60 L	
699-24-34C	2/14/94	B0B063	.20 U			.13 U
699-24-34C	2/14/94	B0B067			17.00 B	
699-24-34C	6/01/94	B0BY32	.20 U			.05 U
699-24-34C	6/01/94	B0BY36			9.50 L	
699-24-34C	8/25/94	B0CBM4	.20 U			.05 U
699-24-34C	8/25/94	B0CBM8			19.00 B	
699-24-35	11/03/93	B09JQ2	.20 U			.13 U
699-24-35	11/03/93	B09JQ6			14.00	
699-24-35	2/10/94	B0B068	.20 U			.13 U
699-24-35	2/10/94	B0B072			8.30 BLQ	
699-24-35	6/01/94	B0BY37	.20 U			.05 U
699-24-35	6/01/94	B0BY38	.20 U			.05 U
699-24-35	6/01/94	B0BY45			4.40 U	
699-24-35	6/01/94	B0BY46			4.40 U	
699-24-35	8/25/94	B0CBN3	.20 U			.05 U
699-24-35	8/25/94	B0CBN7			13.00 B	
699-25-34C	11/03/93	B09JQ7	.20 U			.13 U
699-25-34C	11/03/93	B09JR1			14.00	
699-25-34C	2/22/94	B0B073	.20 U			.13 U
699-25-34C	2/22/94	B0B077			4.50 BL	
699-25-34C	6/21/94	B0BY47	.20 U			.05 U
699-25-34C	6/21/94	B0BY51			9.40 L	
699-25-34C	8/25/94	B0CBN8	.20 U			.05 U
699-25-34C	8/25/94	B0CBP2			10.00 B	
699-26-35A	11/03/93	B09JR2	.20 U			.13 U
699-26-35A	11/03/93	B09JR6			18.00	
699-26-35A	2/03/94	B09ZT1		11.00 B		
699-26-35A	2/03/94	B0B078	.20 U			.13 U
699-26-35A	2/03/94	B0B082			10.00 B	
699-26-35A	6/01/94	B0BY52	.20 U			.05 U
699-26-35A	6/01/94	B0BY56			4.40 U	
699-26-35A	8/17/94	B0CBG9	.22 L			.05 U
699-26-35A	8/17/94	B0CBH3			5.30 L	

For explanation of this table, see Section 1.4 of report.

Table 5.2A-3. Contamination Indicator Parameters for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (3 sheets)

Well Name	Collection Date	Sample Number	COND FIELD µmho 1/.	COND LAB µmho 1/.	pH FIELD .01/6.5-8.5s	pH LAB .01/6.5-8.5s	TOC ppb 320/.	TOX ppb 5/.
699-22-35	2/22/94	B09FP1	698	730	7.22	7.20	300 L	42.3
		B09FP2	697	730	7.22	7.20	400 L	38.2
		B09FP3	698	730	7.22	7.20	300 L	33.0
		B0B039	695	730	7.21	7.20	300 L	37.1
	6/07/94	B0BY02	701	710	6.99	7.10	320 U	34.3
		B0BY03	703		6.98		340 L	29.4
		B0BY04	704		6.98		320 U	29.0
		B0BY05	699		6.98		320 U	35.1
	8/31/94	B0CBH9	722	730	6.76	6.80	320 U	37.0
		B0CBJ0	721		6.73		320 U	36.9
		B0CBJ1	719		6.73		320 U	42.6
		B0CBJ2	719		6.72		330 L	36.5
699-23-34A	12/06/93	B09M30	634	640	6.62	7.90	300 L	30.0
		B09M31	633	640	6.61	8.00	200 L	20.0
		B09M32	634	650	6.61	8.00	300 L	20.0
		B09M33	637	640	6.62	7.90	300 L	30.0
	2/10/94	B0B041	639	640	6.99	7.10	200 U	
		B0B042	641	650	6.97	7.10	200 U	
		B0B043	637	650	6.97	7.10	200 L	
		B0B044	637	650	6.97	7.10	200 U	
	6/06/94	B0BY07	645	640	6.87	6.70	320 U	29.2
		B0BY08	644		6.86		320 U	29.8
		B0BY09	644		6.82		320 U	31.1
		B0BY10	642		6.79		320 U	29.5
	8/25/94	B0CBJ4	604	640	6.92	6.70	320 U	28.3
		B0CBJ5	603		6.75		320 U	30.0
		B0CBJ6	601		6.73		340 L	28.5
		B0CBJ7	601		6.72		320 U	28.6
699-23-34B	2/22/94	B09FP4	664	710	7.21	7.20	200 U	34.5
		B09FP5	669	710	7.25	7.10	200 L	30.0
		B09FP6	670	710	7.29	7.20	200 U	35.0
		B0B046	664	710	7.23	7.20	200 L	34.1
	6/02/94	B0BY12	706	710	6.92	7.00	320 U	38.0
		B0BY13	702		6.90		320 U	35.2
		B0BY14	706		6.89		320 U	42.0
		B0BY15	701		6.86		320 U	40.6
	8/31/94	B0CBJ9	693	710	6.92	6.90	500 L	37.7
		B0CBK0	694		6.91		320 L	36.9
		B0CBK1	690		6.90		400 L	39.3
		B0CBK2	693		6.89		320 U	32.7
699-24-33	11/03/93	B09JN2	633	650	7.13	7.20	300 LB	8.0 U
		B09JN3	634	650	7.12	7.20	300 LB	10.0
		B09JN4	634	650	7.11	7.20	300 LB	20.0
		B09JN5	635	650	7.10	7.20	300 LB	10.0
	2/14/94	B0B048	658	650	7.47	7.30	200 L	12.6
		B0B049	662	650	7.45	7.30	200 U	12.2
		B0B050	665	650	7.45	7.30	200 U	11.5
		B0B051	665	650	7.45	7.30	200 U	12.5
	6/06/94	B0BY17	641	640	7.37	7.20	320 U	15.7
		B0BY18	642		7.31		320 U	13.8
		B0BY19	642		7.26		320 U	13.8
		B0BY20	642		7.24		320 U	12.6

Table 5.2A-3. Contamination Indicator Parameters for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (3 sheets)

Well Name	Collection Date	Sample Number	COND FIELD µmho 1/.	COND LAB µmho 1/.	pH FIELD .01/6.5-8.5s	pH LAB .01/6.5-8.5s	TOC ppb 320/.	TOX ppb 5/.
699-24-33	9/14/94	B0CBK4	647	650	6.96	7.20	350 L	10.5
		B0CBK5	647	650	6.96	7.20	320 U	10.4 Q
		B0CBK6	648		6.96		320 U	7.4 Q
		B0CBK7	648		6.95		370 L	13.5
		B0CBK8					320 U	12.5
		B0CBK9					320 U	10.8
		B0CBL0					320 U	10.3
		B0CBL1					320 U	11.4
699-24-34A	11/03/93	B09JN7	592	600	6.76	7.00	500 LB	20.0
		B09JN8	593	600	6.77	7.00	400 LB	20.0
		B09JN9	592	600	6.76	7.00	300 LB	20.0
		B09JP0	590	600	6.78	6.90	300 LB	20.0
	2/10/94	B0B053	600	600	6.75	7.20	300 L	25.8
		B0B054	597	600	6.73	7.10	200 L	23.2
		B0B055	594	600	6.72	7.10	200 U	22.4
		B0B056	593	610	6.72	7.10	200 U	24.8
	6/06/94	B0BY22	598	600	6.74	6.70	320 U	18.7
		B0BY23	596		6.81		320 U	23.2
		B0BY24	595		6.81		320 U	14.9
		B0BY25	591		6.80		320 U	17.7
	9/14/94	B0CBL4	603	600	6.73	6.80	320 U	20.0
		B0CBL5	601		6.73		320 U	17.0
		B0CBL6	603		6.74		320 U	16.2
		B0CBL7	603		6.73		320 U	15.7
699-24-34B	11/03/93	B09JP2	598	610	6.65	7.30	300 LB	20.0
		B09JP3	597	610	6.65	7.10	200 LB	20.0
		B09JP4	595	610	6.65	7.10	300 LB	10.0
		B09JP5	593	610	6.64	7.10	200 U	20.0
	2/10/94	B0B058	612	620	7.02	7.30	300 L	19.7
		B0B059	612	620	7.01	7.30	200 U	20.8
		B0B060	610	620	7.00	7.20	200 L	
		B0B061	608	620	6.98	7.20	300 L	
	6/06/94	B0BY27	612	620	7.20	6.80	320 U	17.7
		B0BY28	612		7.20		320 U	18.1
		B0BY29	611		7.15		320 U	20.4
		B0BY30	606		7.15		320 U	20.3
	8/25/94	B0CBL9	601	620	6.40	7.00	320 U	16.8
		B0CBM0	600		6.63		400 L	17.5
		B0CBM1	605		6.55		320 U	17.9
		B0CBM2	604		6.51		400 L	18.0
699-24-34C	11/03/93	B09JP7	677	700	7.16	7.00	400 LB	20.0
		B09JP8	688	700	7.17	7.00	200 U	20.0
		B09JP9	685	700	7.17	7.00	200 U	20.0
		B09JQ0	685	700	7.17	7.00	200 LB	20.0
	2/14/94	B0B063	704	690	7.12	7.10	200 U	13.5
		B0B064	702	690	7.11	7.10	200 U	13.3
		B0B065	702	690	7.11	7.10	300 L	15.1
		B0B066	700	690	7.11	7.00	200 L	15.7
	6/01/94	B0BY32	749	690	6.87	7.00	320 U	5.0 U
		B0BY33	748		6.88		320 U	21.0
		B0BY34	747		6.97		320 U	14.9
		B0BY35	743		6.97		320 U	19.3
	8/25/94	B0CBM4	671	700	6.59	6.80	320 U	19.2
		B0CBM5	674		6.59		320 U	22.1
		B0CBM6	673		6.61		400 L	21.9
		B0CBM7	674		6.62		320 U	20.5

Table 5.2A-3. Contamination Indicator Parameters for the Solid Waste Landfill Data for Reporting Period October 1, 1993 to September 30, 1994. (3 sheets)

Well Name	Collection Date	Sample Number	COND FIELD µmho 1/.	COND LAB µmho 1/.	pH FIELD .01/6.5-8.5s	pH LAB .01/6.5-8.5s	TOC ppb 320/.	TOX ppb 5/.
699-24-35	11/03/93	B09JQ2	483	500	7.48	7.20	400 LB	8.0 U
		B09JQ3	483	500	7.45	7.20	400 LB	8.0 U
		B09JQ4	483	500	7.44	7.20	300 LB	8.0 U
		B09JQ5	482	500	7.43	7.20	500 LB	8.0 U
	2/10/94	B0B068	504	510	6.60	7.60	200 U	
		B0B069	505	510	6.62	7.50	200 U	
		B0B070	499	510	6.63	7.50	200 L	
		B0B071	502	510	6.66	7.60	200 U	
	6/01/94	B0BY37	535	500	7.11	7.30	320 U	6.9
		B0BY38	534	500	7.14	7.20	320 U	7.9 Q
		B0BY39	535		7.15		320 U	10.7 Q
		B0BY40	531		7.12		320 U	6.1
		B0BY41					320 U	5.3
		B0BY42					400 L	
		B0BY43					320 U	13.9
		B0BY44					320 U	9.3
	8/25/94	B0CBN3	486	500	7.22	7.30	320 U	12.4
		B0CBN4	485		7.22		320 U	13.7
		B0CBN5	482		7.20		320 L	10.7
		B0CBN6	482		7.21		330 L	12.8
699-25-34C	11/03/93	B09JQ7	537	550	7.57	7.30	300 LB	10.0
		B09JQ8	537	550	7.57	7.30	400 LB	8.0 U
		B09JQ9	539	550	7.56	7.30	400 LB	8.0 U
		B09JR0	536	550	7.56	7.30	300 LB	8.0 U
	2/22/94	B0B073	521	550	7.43	7.60	200 U	7.4
		B0B074	518	550	7.39	7.60	200 L	6.8
		B0B075	517	550	7.38	7.50	300 L	8.2
		B0B076	518	550	7.38	7.50	200 L	6.4
	6/21/94	B0BY47	498	550	7.34	7.20	320 U	
		B0BY48	512		7.35		320 U	
		B0BY49	524		7.33		320 U	
		B0BY50	525		7.34		320 U	
	8/25/94	B0CBN8	535	550	7.43	7.30	400 L	9.7
		B0CBN9	535		7.42		320 U	8.2
		B0CBP0	535		7.41		320 U	10.5
		B0CBP1	533		7.40		320 U	10.4
699-26-35A	11/03/93	B09JR2	429	440	7.76	7.50	300 LB	8.0 U
		B09JR3	426	440	7.75	7.50	300 LB	10.0
		B09JR4	428	440	7.73	7.50	300 LB	8.0 U
		B09JR5	425	440	7.74	7.50	400 LB	8.0 U
	2/03/94	B0B078	447	440	7.17	8.40	200 L	5.0 U
		B0B079	444	440	7.20	8.30	200 L	5.0 U
		B0B080	445	440	7.21	8.20	200 L	6.9
		B0B081	443	440	7.24	8.30	200 U	5.0 U
	6/01/94	B0BY52	486	440	7.20	7.50	320 U	5.0 U
		B0BY53	484		7.18		320 U	5.0 U
		B0BY54	484		7.17		320 U	5.4
		B0BY55	482		7.11		320 U	6.9
	8/17/94	B0CBG9	426	440	7.13	7.50	320 L	8.3
		B0CBH0	427		7.12		320 U	6.9
		B0CBH1	428		7.11		320 U	5.1
		B0CBH2	426		7.11		320 U	7.2

For explanation of this table, see Section 1.4 of report.

Table 5.2A-4. Analysis Method Code Definitions.

Method code	Method name
16	SW-846 8240[a]
17	SW-846 8080[a]
19	SW-846 8270[a]
25	SW-846 8010/8020[a]
29	SW-846 8140[a]
30	SW-846 8040[a]
34	SW-846 6010[a]
36	ASTM D-1385[b]
40	SW-846 7421[a]
41	SW-846 7470[a]
42	SW-846 7841[a]
43	SW-846 7060[a]
48	SW-846 7740[a]
49	SW-846 8150[a]
51	SW-846 8280[a]
52	ASTM D-1067-A
54	ASTM D-1426-D
56	SW-846 9010[a]
62	In-house ion chromatography
63	SW-846 9030[a]
65	Standard Methods #209B[c]
67	SW-846 9020[a]
69	SW-846 9131[a]
73	ASTM D-1125-A
93	Field probe, pH
94	Field probe, conductivity
122	SW-846 9060[a]
124	ASTM D-4327-88
125	ASTM D-1293
126	Standard Methods #214A[c]
127	ASTM D-2579-A
130	EPA Method 300.0[d]
135	SW-846 9310, Alpha[a]
136	SW-846 9310, Beta[a]
137	SW-846 9315, Radium[a]
139	ITAS I-129 Low level
140	ITAS Gamma scan
141	ITAS Sr-90
142	ITAS H-3
143	ITAS Tc-99
144	SW-846 9132[a]
145	ITAS Gross U
146	ITAS Isotopic Pu
147	ITAS Am-241
148	ITAS Isotopic U
168	USEPA HACH COD[d]
357	EPA 600, 310.2

[a](EPA 1986).
[b](ASTM 1991).
[c](EPA 1979).
[d](APHA 1989).

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APPENDIX 5.2B

WATER LEVEL MEASUREMENTS

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October 1, 1993 through September 30, 1994.
(4 sheets)

Well	Date	Depth to water (m)	Water level elevation above msl (m)
Solid Waste Landfill Monitoring Wells			
699-23-34	10/12/93	40.11	122.31
	11/03/93	40.11	122.30
	12/27/93	40.16	122.26
699-24-33	10/12/93	37.50	122.28
	11/03/93	37.51	122.27
	11/03/93	37.48	122.29*
	12/27/93	37.55	122.23
	1/10/94	37.54	122.24
	2/14/94	37.54	122.24*
	2/17/94	37.54	122.24
	3/24/94	37.56	122.22
	4/28/94	37.57	122.21
	5/24/94	37.55	122.23
	6/06/94	37.57	122.21*
	6/20/94	37.53	122.25
	7/22/94	37.53	122.25
	8/08/94	37.55	122.23
	9/06/94	37.55	122.23
	9/14/94	37.57	122.21*
699-24-34A	10/12/93	40.43	122.30
	11/03/93	40.43	122.30
	11/03/93	40.42	122.31*
	12/27/93	40.47	122.26
	1/10/94	40.47	122.26
	2/10/94	40.50	122.22*
	2/17/94	40.51	122.22
	3/24/94	40.48	122.25
	4/28/94	40.50	122.22
	5/24/94	40.49	122.24
	6/06/94	40.45	122.28*
	6/20/94	40.46	122.27
	7/22/94	40.45	122.28
	8/08/94	40.48	122.25
	9/06/94	40.48	122.25
	9/14/94	40.50	122.23*

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October 1, 1993 through September 30, 1994.
(4 sheets)

Well	Date	Depth to water (m)	Water level elevation above msl (m)
Solid Waste Landfill Monitoring Wells			
699-24-34B	10/12/93	40.30	122.31
	11/03/93	40.31	122.30*
	11/03/93	40.30	122.31
	12/27/93	40.34	122.27
	1/10/94	40.33	122.28
	2/10/94	40.41	122.20*
	2/17/94	40.32	122.29
	3/24/94	40.35	122.26
	4/28/94	40.38	122.23
	5/24/94	40.36	122.25
	6/06/94	40.31	122.30*
	6/20/94	40.38	122.23
	7/22/94	40.33	122.28
	8/08/94	40.36	122.25
	8/25/94	40.37	122.24*
	9/06/94	40.36	122.25
699-24-34C	10/12/93	40.03	122.30
	11/03/93	40.03	122.30
	11/03/93	40.02	122.31*
	12/27/93	40.07	122.26
	1/10/94	40.07	122.26
	2/14/94	40.03	122.30*
	2/17/94	40.07	122.26
	3/24/94	40.08	122.25
	4/28/94	40.11	122.22
	5/24/94	40.09	122.24
	6/01/94	40.06	122.27*
	6/20/94	40.06	122.27
	7/22/94	40.05	122.28
	8/08/94	40.05	122.28
	8/25/94	40.10	122.23*
	9/06/94	40.09	122.24
699-24-35	10/12/93	41.92	122.31
	11/03/93	41.91	122.32*
	11/03/93	41.90	122.33
	12/27/93	41.96	122.27
	1/10/94	41.96	122.27
	2/10/94	42.03	122.20*

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Well	Date	Depth to water (m)	Water level elevation above msl (m)
Solid Waste Landfill Monitoring Wells			
699-24-35	2/17/94	41.96	122.27
	3/24/94	41.98	122.25
	4/28/94	42.01	122.22
	5/24/94	41.99	122.24
	6/01/94	41.95	122.28*
	6/20/94	41.95	122.28
	7/22/94	41.94	122.29
	8/08/94	41.97	122.26
	8/25/94	41.99	122.24*
	9/06/94	41.97	122.26
699-25-34C	10/12/93	40.90	122.31
	11/03/93	40.94	122.27
	11/03/93	40.90	122.30*
	12/27/93	40.95	122.26
	1/10/94	40.94	122.27
	2/17/94	40.94	122.26
	2/22/94	40.95	122.26*
	3/24/94	40.96	122.25
	4/28/94	40.99	122.22
	5/24/94	40.97	122.24
	6/20/94	40.93	122.27
	6/21/94	40.99	122.22*
	7/22/94	40.93	122.28
	8/08/94	40.96	122.25
	8/25/94	40.97	122.24*
	9/06/94	40.96	122.25
699-26-35A	10/12/93	40.02	122.33
	11/03/93	40.04	122.32
	11/03/93	39.99	122.37*
	12/27/93	40.10	122.26
	1/10/94	40.18	122.18
	2/03/94	40.10	122.25*
	2/17/94	40.19	122.17
	3/24/94	40.14	122.22
	4/28/94	40.24	122.12
	5/24/94	40.22	122.14
	6/01/94	40.07	122.29*
	6/20/94	40.23	122.12

RCRA Water Level Measurement Report Reporting Period
October 1, 1993 through September 30, 1994.
(4 sheets)

Well	Date	Depth to water (m)	Water level elevation above msl (m)
Solid Waste Landfill Monitoring Wells			
699-26-35A	7/22/94	40.11	122.25
	8/17/94	40.08	122.28*
	9/06/94	40.13	122.22

Notes:
1. Water level elevations are calculated by subtracting the measured depth to water from the surveyed elevation for the well.
2. Depth-to-water values are transcribed from field records.
3. Elevations marked with an '*' were measured at the time of sampling.
4. Elevations marked with a '+' are outside of the expected range, and are suspected of error.

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6.0 300 AREA

6.1 300 AREA PROCESS TRENCH

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Westinghouse Hanford Company

The groundwater near the 300 Area Process Trenches has been monitored by a *Resource Conservation and Recovery Act of 1976* (RCRA) interim-status groundwater quality assessment well network since June 1985. The site continues to be regulated by the interim-status regulations under the Hanford Facility RCRA Permit (September 28, 1994). Monitoring wells were constructed in response to a *Consent Agreement and Compliance Order* issued jointly by the Washington State Department of Ecology and the U.S. Environmental Protection Agency (Ecology and EPA 1986). The 300 Area Process Trenches are located within the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) 300-FF-1 and 300-FF-5 operable units. Currently the 300 Area Process Trenches are in the groundwater quality assessment level of monitoring, as discussed in the groundwater monitoring compliance plan (Schalla 1988). A closure/post-closure plan has been written for the 300 Area Process Trenches and is described in DOE (1985).

6.1.1 Facility Overview

The 300 Area Process Trenches are located in the northern portion of the 300 Area (Figures 6.1-1 and 1-1). The two unlined trenches were constructed in 1975. From 1975 until the shutdown of fuel fabrication in 1987 and other 300 Area operations in 1988, the trenches were used for the disposal of most liquid wastes generated in the 300 Area. Waste constituents are described in Schalla et al. (1988). The discharge rate reached a maximum of about 7,600 L/min (2,000 gal/min). Since 1988, the wastewater has consisted of cooling water with small quantities of nonhazardous maintenance and process waste. In July 1991, the trenches were modified as part of an expedited response action (ERA). The modifications of the trenches involved removing bottom sediment from the inflow end of the trench and placing it at the opposite end of the trench behind a berm. The trenches were used on an alternating, as-needed basis. The west trench was rendered inoperable on November 20, 1992. Since then, the east trench receives all discharge. Average discharge to the east trench is about 850 L/min (225 gal/min).

From the surface downward, the geologic units include the Hanford formation, the Ringold Formation, and the Columbia River Basalts. The Hanford formation is 9 to 12 m thick and is comprised of gravelly sand and sandy gravel. The Ringold Formation is approximately 40 m thick and is comprised of two major units. The upper half is comprised of interbedded sandy gravels, gravelly sands, and silty sand. The lower half is comprised of sandy and clayey silt, and is called the lower mud unit. Flows of Columbia River Basalt and intercalated beds of the Ellensburg Formation underlie the Ringold Formation lower mud unit.

The water table is close to the position of the Hanford-Ringold Formations contact, but near the river it rises and falls in response to river level. During average to low river stages, groundwater in the unconfined aquifer enters the 300 Area from the northwest and southwest, flows through the 300 Area in a west-to-east or northwest-southeast direction, and eventually flows into the river. The water table is close to or slightly below the Hanford-Ringold Formations contact. During high water stages the water table can be quickly raised above the Hanford-Ringold Formations contact near the river, and groundwater may temporarily flow in a reverse direction. Channeling in the top of the Ringold Formation further complicates the direction and flow rate of groundwater in the unconfined aquifer. Confined aquifers at depth (below the confining lower mud unit) have an overall greater amount of pressure than the overlying unconfined aquifer, causing any interaquifer flow to be in an upward direction.

6.1.2 Summary of 1994 Activities

Although the well network for the 300 Area Process Trenches is on a semiannual sampling schedule, the network was sampled only once (June 1994) during the annual reporting period for this report (i.e., October 1993 to September 1994). The network was sampled only once because the schedule was shifted from semiannual sampling periods of February and September each year to June and October to correspond to high and low flow levels of the Columbia River. Unfortunately, in the year of the shift, the wells would be only sampled once (June) during the annual reporting period (October 1993 to September 1994). In addition to regular sampling events, well 399-1-17A is sampled quarterly for a limited list of analytes. Water level measurements are taken monthly, in addition to measurements made during sampling.

6.1.3 Sampling and Analysis Program

The general groundwater monitoring program is described in the groundwater monitoring compliance plan (Schalla 1988). Sampling of 300 Area wells is coordinated with the 300-FF-5 CERCLA program so that well trips can be reduced and data are shared.

Currently, the monitoring network for the process trenches has 11 wells. The locations of these wells are shown in Figure 6.1-1. A list of these 11 wells, other wells, and their uses is presented in Table 6.1-1. Groundwater samples are collected semiannually at all wells in the network except well 399-1-17A. Well 399-1-17A is on a quarterly schedule to access changes in groundwater quality near the process trench.

Available analytical results have been reported in the quarterly reports (Borghese 1994a, 1994b; Lindberg 1994, 1995). Analytical constituents are listed in Table 6.1-2.

6.1.4 Groundwater Chemistry

The process trenches are located near other liquid disposal facilities in the 300 Area. Because of the proximity to the North Process Ponds (no longer in service) and sanitary sewer lines, as well as other facilities downgradient from the process trenches, it is difficult to determine constituents in the groundwater that can be directly attributed to the process trenches. Analytical data for the reporting period are available in Borghese (1994a, 1994b) and Lindberg (1994, 1995).

Results of sampling and analysis of groundwater in the 300 Area Process Trenches monitoring network for the one sampling round (June 23-23, 1994) that occurred during 1994 showed that drinking water standards (DWS) were exceeded for two drinking water parameters, four groundwater quality parameters, and three site-specific and other constituents. Results of testing for site contamination indicator parameters were all within DWS. However, results for total organic carbon (TOC) from well 399-1-17A were significantly higher than the historical trend, and a request for analytical data evaluation was submitted for these data.

The two drinking water parameters that exceeded DWSs were unfiltered chromium in four wells and gross alpha in seven wells. The four groundwater quality parameters that exceeded DWSs were unfiltered iron in six wells, filtered iron in one well, unfiltered manganese in three wells, and filtered manganese in three wells. The three site-specific and other contaminants that exceeded DWSs were ^{106}Ru in one well, trichloroethene in one well, and cis-1,2-dichloroethene in one well (Lindberg 1994). The unfiltered chromium, iron, and manganese are probably from the well construction process. Alpha is probably caused by uranium that is disseminated throughout much of the sediment near the water table in the 300 Area by past waste practices. The three site-specific and other contaminants are probably caused by contaminated wastewater discharged directly to the process trenches.

6.1.4.1 Concentration Histories of Waste Indicators. A brief discussion of historical constituents of interest is provided in the following text.

6.1.4.1.1 Uranium. Concentrations of uranium at well 399-1-17A are shown in Figure 6.1-2. Groundwater from well 399-1-17A has been analyzed for uranium since 1987. Before the ERA in July 1991, uranium concentrations were greater than 100 ppb and showed cyclic variations. The cyclic variations were related to river stage fluctuations. However after the ERA, uranium concentrations dropped to much lower values and stayed at the low values through the monitored period. Concentration of uranium at other sampled wells have remained consistent during the past year.

6.1.4.1.2 Gross Alpha. Concentrations of gross alpha activity above the DWS (15 pCi/L) were observed in wells 399-1-10A, 399-1-11, 399-1-12, 399-1-16A, 399-1-17A, 399-2-1, and 399-3-10. These wells historically have had gross alpha values above the DWS. The gross alpha activity is probably from uranium.

6.1.4.1.3 Trichloroethylene/1,2-Dichloroethene. Groundwater collected from well 399-1-16B, which monitors the bottom of the unconfined aquifer, historically has had values of trichloroethene and cis-1,2-dichloroethene above the DWSs of 5 and 70 ppb, respectively. During the current reporting period the results for these two constituents at well 399-1-16b were 5.40 and 130 ppb, respectively.

6.1.4.1.4 Tritium. Although tritium is not indicative of a contaminant from the process trenches, the plume emanating from the 200 Areas is influencing groundwater in the 300 Area (see Figure 2-5). Figure 6.1-3 shows the change in concentration over time for selected wells in the 300 Area. Well 399-1-18A, the northernmost well in the network and an upgradient well, has the highest concentration of tritium. Wells further south detect less tritium.

6.1.4.2 Distribution of Waste Constituents. The distribution of uranium in the groundwater beneath the 300 Area has changed since July 1991. Data before July 1991 showed an uranium plume with the high (120 pCi/L) centered around well 399-1-17A located at the inflow end of the process trenches (Evans et al. 1992). The 1992 and 1993 data show that the marked decrease in uranium at well 399-1-17A that occurred post-ERA has been sustained (see Figure 6.1-2).

6.1.5 Groundwater Flow

6.1.5.1 Groundwater Flow Direction. The groundwater flow direction in the unconfined aquifer near the 300 Area Process Trenches is predominantly to the southeast with slight changes caused by fluctuations in Columbia River stage. Figure 6.1-4 shows the elevation of the water table June 22-23, 1994, when the river stage was very near the high for the year. Sometimes a localized flow reversal occurs when the river stage is higher than the water level in the unconfined aquifer. The area involved in these flow reversals depends on the elevation of the high river stage and its duration. On June 22 and 23, 1994, the reversal was only experienced along the shore of the river and inland in the area of well 399-3-12. In the area of the process trenches the flow direction in the unconfined aquifer remained toward the southeast. Figure 6.1-5 shows the elevation of the water table from September 20 to 21, 1994, during the low stage period for the Columbia River. Flow direction was to the southwest as it was in June. Water level data are collected monthly and reported in quarterly reports (Borghese 1994a, 1994b; Lindberg 1994, 1995).

There is a vertical head difference, with the gradient in an upward direction, between the gravels beneath the Ringold Formation lower mud unit and the unconfined aquifer. At wells 399-1-17A and 399-1-17C the head difference is about 11 m (35 ft). There is a slight downward gradient within the unconfined aquifer observed in the 399-1-17 and 399-1-16 well clusters.

6.1.5.2 Rate of Flow. The flow rate in the top of the unconfined aquifer has previously been reported as about 10.6 m/d (35 ft/d) near the process trenches (Schalla et al. 1988) based on a perchloroethene spill data. The rate of flow can also be estimated roughly by using the Darcy equation.

$$v = \frac{Ki}{n} \tag{1}$$

where:

v = Average linear groundwater velocity
K = Hydraulic conductivity
i = Hydraulic gradient
n = Effective porosity.

Schalla et al. (1988) reported values of hydraulic conductivity for the unconfined aquifer ranging from 150 to 15,240 m/d (500 to 50,000 ft/d). These values were determined from pumping tests. The hydraulic gradient near the process trenches, estimated from the September 1994 water table map, averages approximately 0.0007. This gradient is about average for the year. Estimates of effective porosity for the unconfined aquifer range from 0.10 to 0.30. Using the above-stated values for input parameters to the Darcy equation, the range of groundwater flow velocity is approximately 0.35 to 106.7 m/d (1.15 to 350 ft/d). The large range in flow velocity values is a result of the large range in values of hydraulic conductivity reported for the aquifer. The range in hydraulic conductivity may be attributed to facies variations within and between the Hanford and Ringold formations.

6.1.5.3 Evaluation of Monitoring Network. Groundwater flow has not changed significantly since the 300 Area Process Trenches monitoring network was designed. The network is still adequate to detect contamination from the trenches.

6.1.6 References

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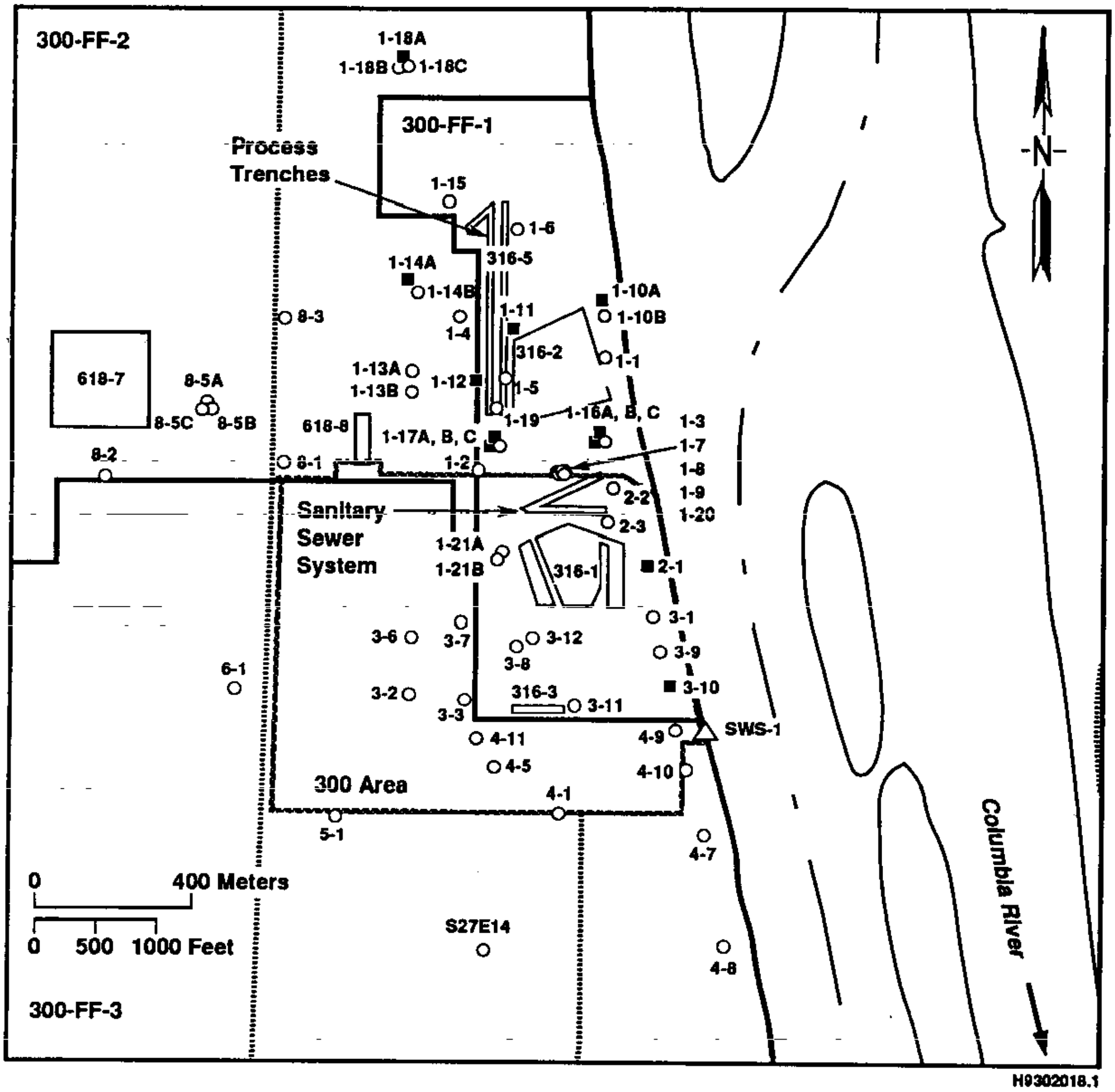
Schalla, R., R. L. Aaberg, S. P. Airhart, D. J. Bates, J. V. M. Carlile, C. S. Cline, D. I. Dennison, M. D. Freshley, P. R. Heller, E. J. Jensen, K. B. Olsen, R. G. Parkhurst, J. T. Rieger, R. W. Wallace, and E. J. Westergard, 1988, *Interim Characterization Report for the 300 Area Process Trenches*, PNL-6716, Pacific Northwest Laboratory, Richland, Washington.

Figure 6.1-1. Facility and Well Location Map.



○ 1-12 Well Location and Number (Wells Prefixed by 399-, Except Those Beginning with S are Prefixed with 699-)

■ 4-7 Monitoring Network Well

△ SWS-1 Surface-Water Monitoring Station

.... Roads

Figure 6.1-2. Uranium Concentrations at Well 399-1-17A.

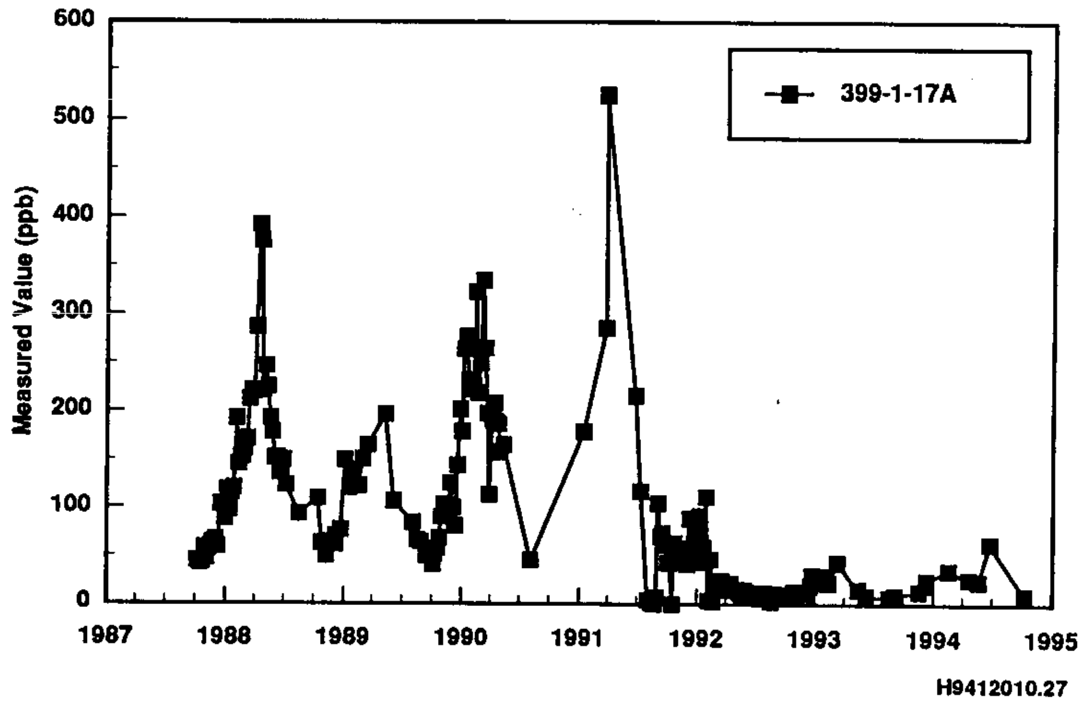


Figure 6.1-3. Tritium Activity in Selected 300 Area Wells.

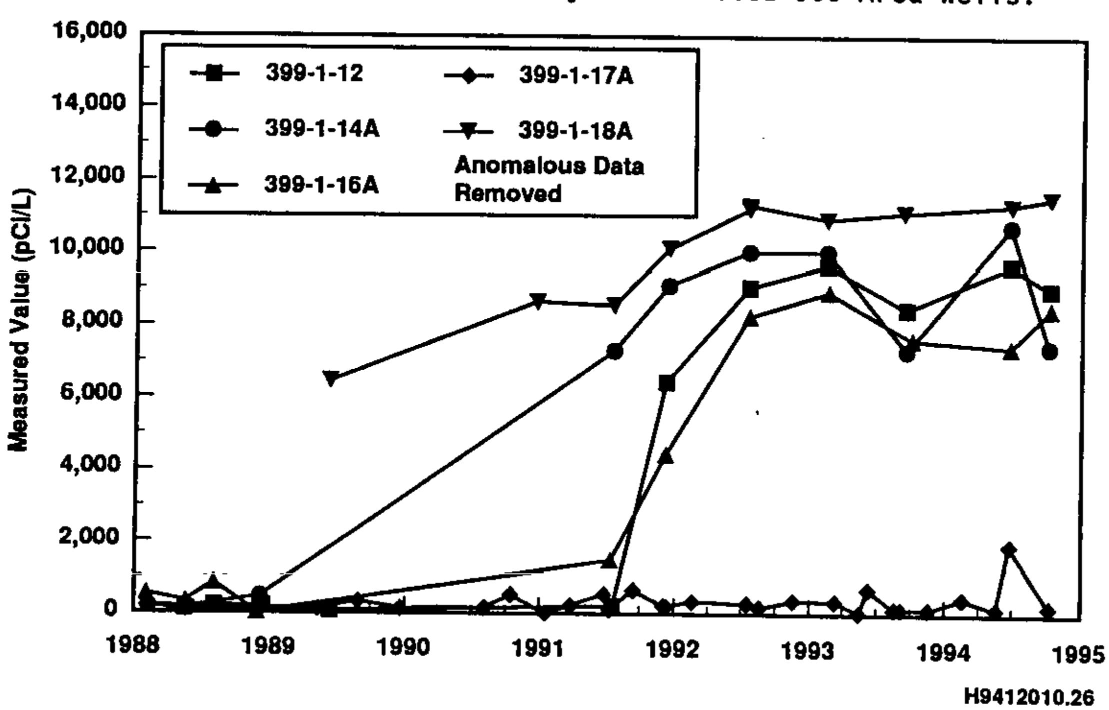
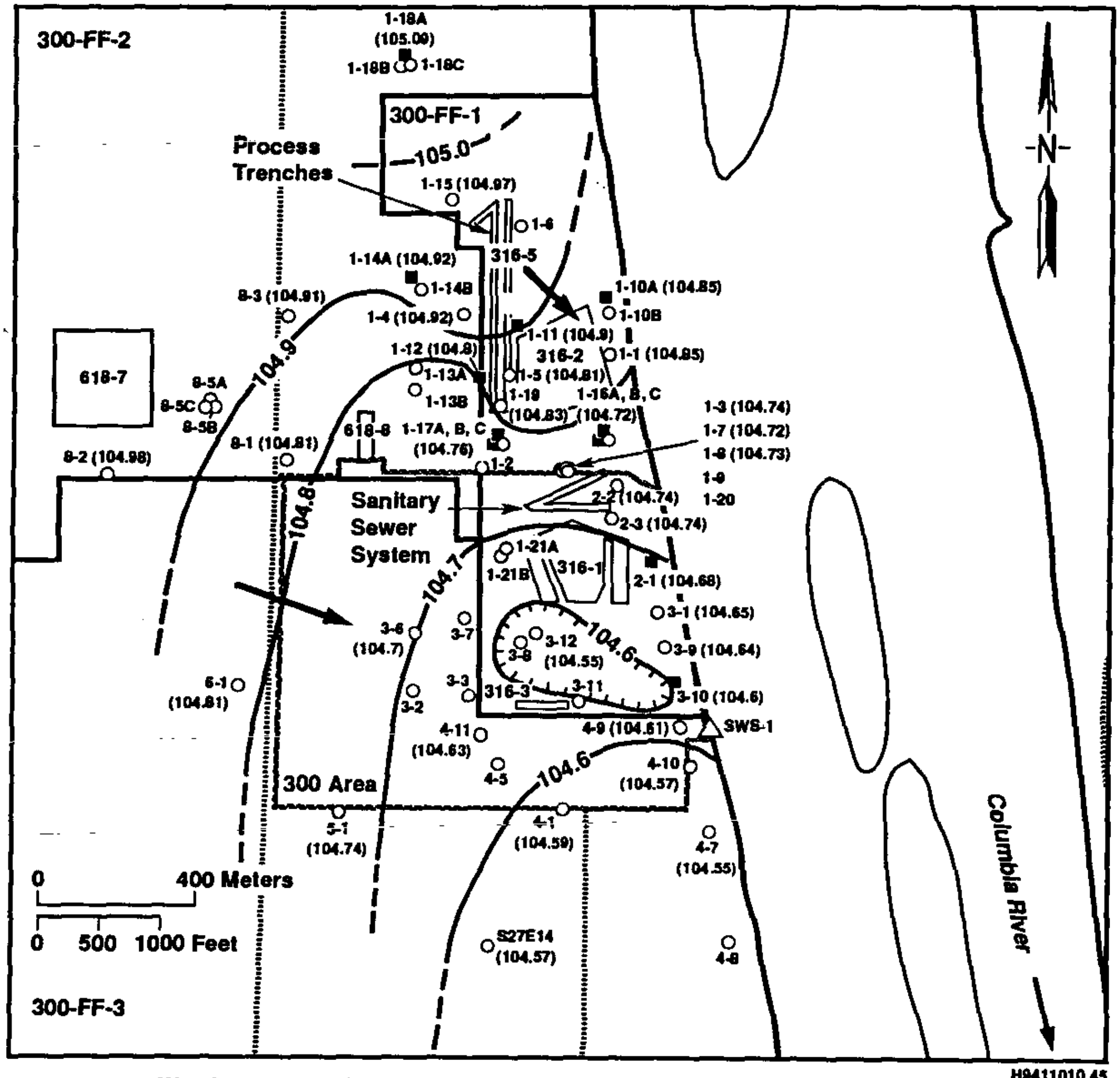


Figure 6.1-4. Water Table Elevation Map, June 22-23, 1994.



○ 5-1 (104.74) Well Location and Number (Wells Prefixed by 399-, Except Those Beginning with S are Prefixed with 699-) (Number in parenthesis is water table elevation in meters)

■ 1-14A (104.92) Monitoring Network Well (Number in parenthesis is water table elevation in meters)

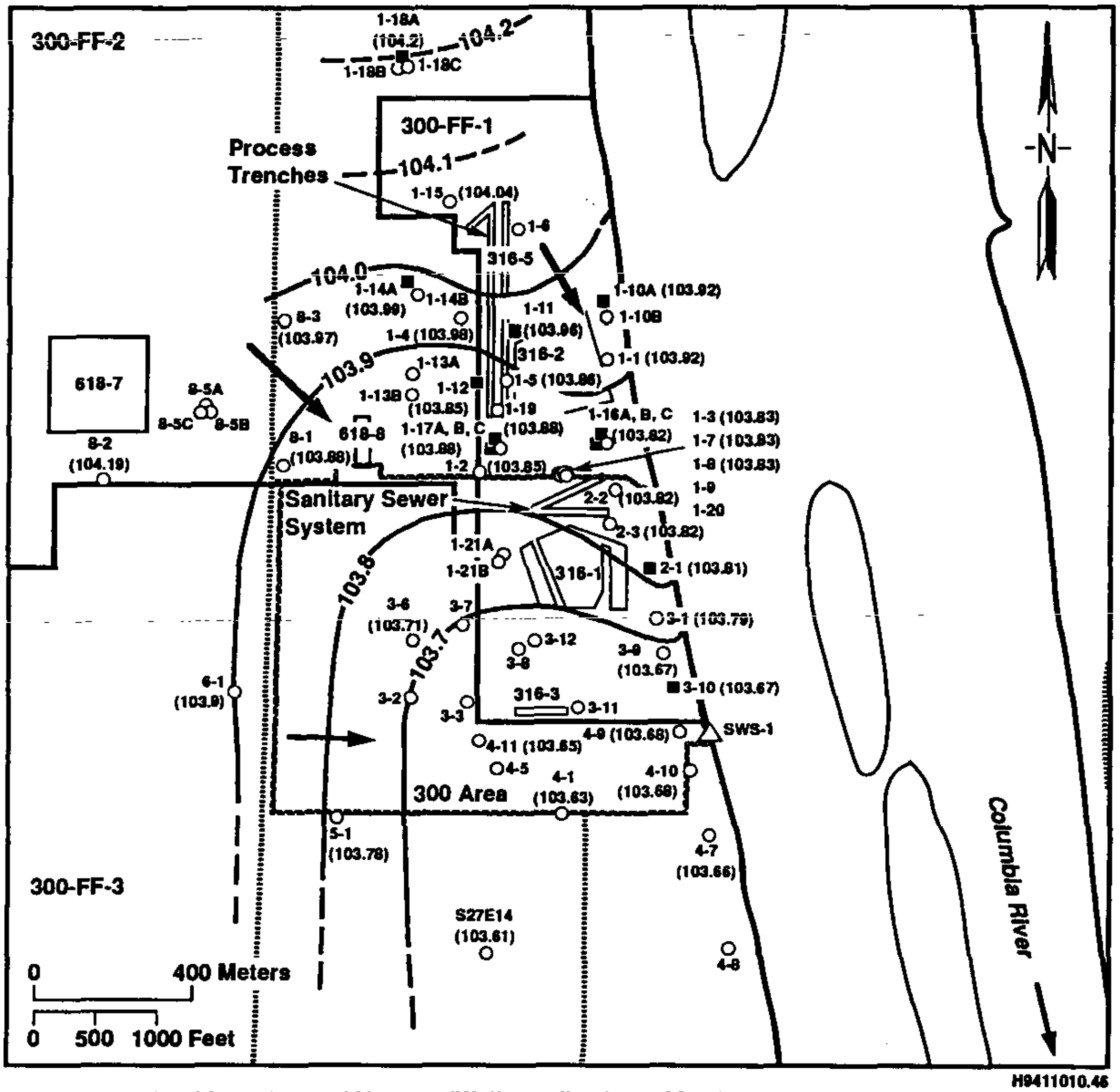
△ SWS-1 Surface-Water Monitoring Station

.... Roads

—104.7— Water Table Contour in Meters. Contour Interval = 0.1 Meters. (Note: Change meters to feet by multiplying by 3.28).

⟶ Generalized Groundwater Flow Direction

Figure 6.1-5. Water Table Elevation Map, September 20-21, 1994.



○ 5-1 (103.78)	Well Location and Number (Wells Prefixed by 399-, Except Those Beginning with S are Prefixed with 699-) (Number in parenthesis is water table elevation in meters)
■ 1-12 (103.85)	Monitoring Network Well (Number in parenthesis is water table elevation in meters)
△ SWS-1	Surface-Water Monitoring Station
....	Roads
--103.8--	Water Table Contour in Meters. Contour Interval = 0.1 Meters. (Note: Change meters to feet by multiplying by 3.28).
——▶	Generalized Groundwater Flow Direction

Table 6.1-1. Monitoring Wells Used for the 300 Area Process Trenches.

Well	Aquifer	Sampling frequency	Water levels	Well standards
399-1-10A[86]	Top of unconfined	SA	M	RCRA
399-1-11[86]	Top of unconfined	SA	M	RCRA
399-1-12[86]	Top of unconfined	SA	M	RCRA
399-1-14A[86]	Top of unconfined	SA	M	RCRA
399-1-16A[86]	Top of unconfined	SA	M	RCRA
399-1-16B[87]	Bottom unconfined	SA	M	RCRA
399-1-17A[86]	Top of unconfined	Q	M	RCRA
399-1-17B[86]	Bottom unconfined	SA	M	RCRA
399-1-18A[86]	Top of unconfined	SA	M	RCRA
399-2-1[48]	Top of unconfined	SA[a]	M	PRE
399-3-10[76]	Top of unconfined	SA[a]	M	PRE

Notes: Shading denotes upgradient wells. Superscript following well number denotes the year of installation.

[a] = Well is sampled for supporting data.
M = frequency on a monthly basis.
PRE = well was constructed before RCRA-specified standards.
Q = frequency on a quarterly basis.
RCRA = well is in compliance with RCRA standards.
SA = frequency on a semiannual basis.

Table 6.1-2. Constituents Analyzed in the 300 Area Process Trenches.

Contamination indicator parameters		
pH	Total organic carbon	
Specific conductance	Total organic halogen	
Groundwater quality parameters		
Chloride	Manganese	Sodium
Iron	Phenols	Sulfate
Drinking water parameters		
2,4-D	Chromium	Lead
2,4,5-TP Silvex	Coliform bacteria	Mercury
Alpha-BHC	Delta-BHC	Methoxychlor
Arsenic	Endrin	Nitrate
Barium	Fluoride	Radium
Beta-BHC	Gross alpha	Selenium
Cadmium	Gross beta	Silver
Site-specific and other parameters		
4,4-DDE	Cobalt	Phosphate
4,4-DDT	Copper	Potassium
Aldrin	Dieldrin	Tin
Alkalinity	Endosulfan	Toxaphene
Antimony	Endrin aldehyde	Tritium
Arochlor 10, 12	Heptachlor	Uranium
Beryllium	Magnesium	Vanadium
Bromide	Nickel	Volatile organics
Chlordane	Nitrate	Zinc

BHC = benzone hexachloride.

APPENDIX A

QUALITY CONTROL

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A.0 QUALITY CONTROL PROGRAM

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A.1 INTRODUCTION

The *Resource Conservation and Recovery Act of 1976* (RCRA) Quality Control (QC) program is based on guidance from the U.S. Environmental Protection Agency (EPA), the *Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document* (EPA 1986a), and Chapter 1, "Quality Control," from *Test Methods for Evaluating Solid Waste* (EPA 1986b).

A.1.1 Data Quality Objectives

The QC program uses the five measures of data quality: precision, accuracy, representativeness, completeness, and comparability, along with applicable program-specific quality parameters to evaluate the quality of the data and the analytical laboratories analyzing the samples (WHC 1992a). Target values for precision and accuracy are specified in the *Quality Assurance Project Plan for RCRA Groundwater Monitoring Activities* (WHC 1992b).

1. Precision is evaluated using data results from laboratory duplicates, matrix spike duplicates (see Section A.3), field duplicates, and blind samples (see Section A.2).

2. Accuracy is evaluated using data results from laboratory matrix spikes; laboratory control samples; EPA Water Pollution (WP), Water Supply (WS), and Interlaboratory Performance Evaluation Programs (see Section A.3); and by blind samples (see Section A.2).

3. Representativeness expresses the degree to which RCRA facility groundwater monitoring data represent the actual composition of the groundwater in the aquifer. Goals for data representativeness for groundwater monitoring programs are addressed qualitatively by the specification of well construction, sampling locations, sampling intervals, and sampling and analysis techniques in the groundwater monitoring plan for each RCRA facility.

4. Completeness is defined as the percentage of measurements that are judged to be valid. Completeness is determined by the number of data unflagged during the validation process, divided by the total number of data evaluated, and multiplied by 100. The calculated percentages used in reporting completeness are conservative figures and are based on the data flags P, F, Q, and H.

5. Comparability is used to ensure that samples analyzed by different laboratories or by the same laboratory over different time periods are comparable. For 1994, only the primary hazardous chemistry and radiochemistry laboratories were requested to analyze samples and submit data. Samples were analyzed in accordance with *Test Methods for Evaluating Solid Waste* (EPA 1986b) and other applicable approved

methods. Comparability of field measurements is determined by following approved sampling procedures that ensure consistency among sampling events.

A.2 EXTERNAL QUALITY CONTROL PROGRAM

The external QC program uses three kinds of QC samples to evaluate quality in the field and laboratory. These are field duplicates, field blanks, and blind samples.

The analytical results of QC samples are judged to be acceptable if the following evaluation criteria are met.

- Field duplicates--Results of field duplicate pairs must have precision within 25%, as measured by relative percent difference.

- Blanks--Four kinds of blanks are used to check for contamination resulting from field activities and/or bottle preparation. These are full trip, daily trip, field transfer, and bottle blanks.

  Except for common laboratory contaminants, results above the limit of two times the method detection limit (MDL) are identified as suspected contamination. For common laboratory contaminants, such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, sample results less than five times the MDL are qualified as nondetects.

- Blind samples--Results must fall within 2.0 standard deviations from the mean recovery of the known concentration of samples submitted to the laboratory.

Table A-1 provides a summary of the QC results available for 1994.

Tables A-2 and A-3 summarize the total number of field blanks and field duplicates outside of the QC limit per analyte for 1994. Analytes not listed in Tables A-2 or A-3 were 100% acceptable for field blanks or field duplicates.

Throughout the year, turbidity has continued to exceed the QC limit in field blanks. The source of the problem has not yet been identified. Recently the water system used to fill the blank bottles was tested for turbidity. The water proved to be very clear. Also, the laboratory's quarterly quality control report does not indicate that there have been any problems with the analysis of turbidity. A possible source of the problem (too many field blanks exceeding the 2*MDL limit) with turbidity may stem from a very low MDL. This limit may be too stringent to apply to groundwater. Efforts are underway to obtain an explanation for this trend.

Total carbon, methylene chloride, and ammonium ion are three constituents with a high percentage of results exceeding QC limits. Virtually all of these results were qualified with a 'B,' which indicates that the laboratory blanks associated with those samples were contaminated.

For field duplicates, at least half of the results for zinc and lead were qualified with a 'B.' Many were qualified with a 'U,' which means nondetect, and, in general, those that were not qualified with a 'U' were qualified with an 'L.' This indicates that results below and just above the MDL were compared and the relative percent difference was calculated. However, values below or just above the MDL are not quantifiable, and may have poor precision. Twenty-five percent of total organic halogen (TOX) values exceeded the QC limit. This supports the fact that the method of measuring organic halides is not precise and that less stringent limits should be considered.

Performance evalution samples were sent out twice during the annual reporting period and were reported in the January through March 1994 and the July through September 1994 quarterly reports. Performance evaluation standards for TOX, total organic carbon (TOC), inductively coupled plasma metals, and phenols were sent out during the reporting period. Eighteen out of the nineteen sample results fell within acceptable limits for the primary hazardous chemistry laboratory for the year.

A.3 INTERNAL QUALITY CONTROL PROGRAM

The internal QC program uses four types of QC data to establish and monitor performance in the laboratory. These data are laboratory blanks, matrix spikes, matrix duplicates, and EPA studies (WP and WS).

Every quarter each contracted laboratory supplies its own QC report, in the form of precision and accuracy, that includes data quality information on matrix spikes, matrix duplicates, and blanks. The contracted laboratories also report their results for the EPA's WP, WS, and radiochemical intercomparison studies quarterly. The results of EPA studies independently verify the level of laboratory performance and are expressed as the percentage of EPA-accepted results. Each half-year the contracted laboratories also supply an MDL/minimum detectable concentration (MDC) report. The MDLs and MDCs are required to be below the contractually required quantitation limit (CRQL). The CRQL is not associated with a quantitation limit as the name suggests; it is intended to be the lowest analyte concentration in a given matrix that a laboratory can be expected to detect consistently. The CRQL is agreed on under the contractual statement of work. A laboratory nonconformance report (NCR) is issued when the MDL is greater than the CRQL. Westinghouse Hanford Company (WHC) reviews each of these reports and summarizes the results in this section.

Precision and accuracy results from the primary contract laboratories, summarized in Table A-4, indicate the performance of all customers submitting water matrix samples. WHC samples represent only a part of the performance summary.

Radiochemistry precision and accuracy figures are gleaned from the radiochemistry laboratory's quarterly report, with percent acceptability calculated from duplicates and spikes, respectively. These results, along with radiochemistry blank data, are summarized in Table A-4.

A.4 NONCONFORMANCE/INCIDENT REPORTS

NCR and incident reports are methods of documentation by which contract laboratories can inform laboratory contractors and their customers of any problems encountered with the analysis, data, and/or data deliverable. This method of documentation is intended to identify occurrences, deficiencies, and/or issues that may potentially have an adverse effect on the data integrity. These may include, but are not limited to the following:

- Lost sample
- Broken bottles
- Instrument malfunctions
- Calibration standards out of acceptable range
- Laboratory control standards out of acceptable range
- Matrix spike recovery out of acceptable range
- Blank contamination
- Procedural noncompliance
- Chain-of-custody discrepancies
- Shipping temperatures out of acceptable range
- Misreported data.

During the 1994 reporting year 91 NCR and incident reports were transmitted, affecting 445 data points. There were 75 reports transmitted by the hazardous chemistry laboratory and 16 reports transmitted by the radiochemistry laboratory. The reports represent a 35% decrease in the number of incident reports transmitted during fiscal year 1994 as compared to fiscal year 1993. The reports describe incidents that affect either groundwater samples or external QC samples (e.g., trip blanks, bottle blanks).

The reports transmitted by the hazardous chemistry laboratories affect 432 data points, 161 of which were rejected. The rejected data were primarily attributed to broken sample containers received at the laboratories. Additionally, 271 analytical results were evaluated as being suspect. These data points should be used for trending purposes only. The suspect data are attributed to TOX samples that missed holding times and to QC sample results that were outside of the acceptable range.

The reports transmitted by the radiochemistry laboratory affect 13 data points, 7 of which were rejected. The rejected radiochemistry data also were attributed to broken sample containers received at the laboratories. Six data points have been determined to be suspect. The suspect data are attributed to sample matrix effects that have prevented the laboratory from achieving contractual detection limits. The incident reports received from the laboratories during this reporting year have been instrumental in identifying potential issues for laboratory surveillances.

A.5 QUALITY ASSURANCE OCCURRENCES

Quality assurance (QA) occurrences are situations that potentially affect the quality of the data. These situations are discussed through summaries of inspections of laboratory services and/or system and performance audits/ surveillances. Inspection of laboratory services and/or system and performance audits/surveillances for the RCRA groundwater monitoring program are performed throughout the year by the laboratory contractor, WHC, and/or the U.S. Department of Energy on various aspects of this program. QA requirements and data quality objectives are defined in the *Quality Assurance Project Plan for RCRA Groundwater Monitoring Activities* (WHC 1992b). Results of these oversight activities are documented with the audit/surveillance and/or inspecting organization(s).

During the 1994 reporting period (October 1, 1993 to September 30, 1994), two decisions were made that affected the TOX analysis: (1) WHC procured a (secondary) hazardous chemistry laboratory for the analysis of TOX, and (2) WHC determined that all TOX data received from the (primary) hazardous chemistry laboratory were unusable and would be considered at best suspect. These decisions were based on unacceptable QC results, numerous documented cases of procedural noncompliance, and the number of unresolved findings and observations associated with the TOX analysis (DOE-RL 1994). The TOX data reported in this annual report reflect the work of the secondary hazardous chemistry laboratory.

During the reporting period WHC performed three inspections in conjunction with the contract administrator. The first inspection was performed at the primary hazardous chemistry laboratory on May 2-6, 1994. The purpose of this inspection was to verify compliance with written QA and QC requirements. The following are findings and observations as determined by the inspection team.

Findings:

- The contractor failed to track and verify implementation of corrective actions, as required by the contract.
- Noncompliances were found with the laboratory's procedures governing document control. Multiple instances were found of effective dates for procedures preceding approval dates.
- Noncompliances were found with the contractual requirement for annual review of procedures.
- Deficiencies exist in the traceability to specific procedures and standards used for the analysis of samples.
- Noncompliances were found in the laboratory's procedural and contractual requirements for training.
- Deficiencies and inconsistencies exist in the control charting and tracking for both analysis and reporting purposes.

Observations:

- The contract laboratory was unable to clearly explain the responsibilities of its QA organization as applicable to WHC samples.
- It was unclear whether the laboratory has an effective program in place to control contamination.

The corrective action for the findings and observations are scheduled to be provided after the printing of this report.

The second inspection was performed at the radiochemistry laboratory on July 6-8, 1994. The official report has not been released and a summary will provided during the next reporting period.

The third inspection was performed at Columbia Biomedical Laboratories (CBML) on August 8-10, 1994. The purpose of the inspection was to determine compliance by CBML with the Pacific Northwest Laboratory contract regarding QA and QC for coliform and biological oxygen demand analyses.

The inspection team found evidence supporting two findings:

Finding #1: CMBL had not followed the requirements delineated in their QA manual.

Finding #2: CMBL had not met all Pacific Northwest Laboratory contract and CBML QA manual requirements for planning and implementing surveillances and audits.

The corrective action for the findings is scheduled to be provided after the printing of this report.

A.6 LIMIT OF DETECTION, LIMIT OF QUANTITATION, AND METHOD DETECTION LIMIT--C. J. Chou

The concentration at which an analyte can be detected depends on the variability of the blank response. For purpose of this discussion, the 'blank' is taken to be a method blank. The limit of detection (LOD) is defined as the lowest concentration level is statistically different from a blank (Currie 1988). In general, it is calculated as the mean concentration in the blank plus 3 standard deviations of that concentration (EPA 1987). The blank corrected LOD is simply three times the blank standard deviation. At 3 standard deviations from the blank mean, the false positive error rate and the false negative error rate are each about 7% (Miller and Miller 1988, p. 116). A false positive error is an instance when an analyte is declared to be present but is, in fact, absent. A false negative error is an instance when an analyte is declared to be absent but is, in fact, present.

The limit of quantitation (LOQ) is defined as the level above which quantitative results may be obtained with a specified degree of confidence (Keith 1991). It is calculated as the blank mean plus 10 standard deviations of the blank (EPA 1987). The blank corrected LOQ is 10 times the blank standard deviation. The LOQ is most useful for defining the lower limit of the useful range of concentration measurement technology. When the analyte signal is 10 times larger than the standard deviation of the blank measurements, there is a 95% probability that the true concentration of the analyte is ± 25% of the measured concentration. The LOD and LOQ are shown graphically in Figure A-1. For purpose of illustration, the numbers appearing in this figure are the respective blank mean, LOD, and LOQ for TOC and TOX (see Table A-5).

The MDL is defined as the minimum concentration of a substance that can be measured and reported with a 99% confidence that the analyte concentration is greater than 0. The MDL is determined from analysis of a sample in a given matrix containing the analyte (Currie 1988). The MDL is 3.14 times the standard deviation of the results of 7 replicates of a low-level standard. Note that the MDL as defined above is based on the variability of the response of low-level standards rather than on the variability of the blank response.

For this RCRA annual report, only TOC, TOX and radionuclide field blank data are available for LOD and LOQ determinations. The field blanks are quality control samples that are introduced into a process to monitor the performance of the system. The use of field blanks to calculate LOD and LOQ is preferred over the use of laboratory blanks because field blanks provide a measure of the errors in the entire sampling and analysis system. Methods to calculate LOD and LOQ are described in detail in DOE-RL (1991, Appendix A). The results of the LOD and LOQ determinations for 1994 RCRA sampling at the Hanford Site are shown in Tables A-5 through A-19.

Because of the lack of blanks data for other constitutes of concern, WHC deemed it necessary to calculate approximated LOD and LOQ values using variability information obtained from low-level standards. As shown in Figure A-1, the values along the horizontal axis are measured in units of 'standard deviation' of the measurement process (i.e., based on well-known blank). If low-level standards are used, the variability of the difference between the sample and blank response is increased by a factor of $\sqrt{2}$ (Currie 1988, p. 84). The formulas are summarized below:

$$\text{MDL} = 3.14 * s$$

$$\text{LOD} = 3 * (\sqrt{2} * s) = 4.24 * s$$

$$\text{LOQ} = 10 * (\sqrt{2} * s) = 14.14 * s$$

where s denotes standard deviation from the seven replicates of the low-level standard.

The results of MDL, LOD, and LOQ calculations, for other constituents of concern, are shown in Table A-20.

A.7 QUALITY CONTROL DEFINITIONS

Accuracy--The closeness of agreement between an observed value and a true value. Accuracy is assessed by means of reference samples and percent recoveries.

Blind sample--A sample that contains a concentration of analyte that is known to the supplier but unknown to the analyzing laboratory. The analyzing laboratory is informed that the sample is a QC sample and not a field sample. The blind, the double blind, and the matrix-matched double blind samples are used to assess accuracy and monitor the performance of the analytical laboratory(ies) with prepared or purchased materials from EPA QC samples/ concentrates or primary materials.

Bottle blank--A sample that contains only Type II reagent water. The bottle blank contains one sample for each bottle size, with at least enough bottles to include all constituents analyzed by a specific project, except radionuclides. Bottle blanks shall be submitted to the primary laboratory per lot of bottles. Bottle blanks are filled in the analytical laboratory under the sample preparation procedures. Bottle blanks do not go into the field.

Contractually required quantitation limit--A value intended to be the lowest analyte concentration in a given matrix that the laboratory can be expected to achieve consistently; agreed on under the contract statement of work.

Daily trip blank--A sample that contains only Type II reagent water. The daily trip blank is used to check for sample contamination by volatile organic compounds arising from conditions encountered during the collection of samples. The daily trip blank is not opened in the field. One daily trip blank is collected for each day sampling occurs.

Double blind sample--A sample that contains a concentration of analyte that is known to the supplier but is unknown to the analyzing laboratory. The analyzing laboratory is not informed that the sample is a QC sample. All attempts are made to make this sample appear like a field sample. For example, the double blind sample should be submitted to the laboratory within the same time period and with a sample identification number similar to that of the field samples. The double blind sample does not include matrix matching.

External quality control sample--Any QC sample prepared without the knowledge of the analytical laboratory.

Field duplicate sample--A sample used to determine repeatability of an analytical measurement on identical samples collected as close as possible to the same time at the same location. These samples are stored in separate containers and are analyzed independently by the same laboratory.

Field transfer blank--A sample that contains only Type II reagent water. The blank field transfer blank is used to check for sample contamination by volatile organic compounds arising from conditions encountered during the collection of samples. The field transfer blank is taken during the collection of samples. The field transfer blank is filled at the sampling site by pouring Type II reagent water from a cleaned container into a volatile organic analysis vial. At least 1 field transfer blank is collected for each 20 samples, or 1 per sampling batch.

Full trip blank--A sample that contains only Type II reagent water and preservative, as required. A full trip blank is used to check for contamination in sample bottles and sample preparation. The full trip blank is analyzed for all constituents of interest on all types of sample bottles used during that sampling period. The frequency of collection for a full trip blank is 1 per 20 samples, or 1 per sampling batch. A full trip blank is filled in the analytical laboratory under the sample preparation procedures. The full trip blank is not opened in the field.

Internal quality control sample--Any QC sample prepared by the analytical laboratory and used to establish and monitor the quality of the analytical laboratory.

Limit of detection--The lowest concentration level that is statistically different from a blank. This is calculated by the average blank signal plus three standard deviations for the blank analyses (see Appendix B for more detail).

Matrix-matched double blind sample--A matrix-matched double blind sample contains a concentration of analyte that is known to the supplier but unknown to the analyzing laboratory. The sample matrix has been altered to closely match that of the field samples.

Method detection limit--The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, and is determined from analysis of a sample in a given matrix type containing the analyte.

Minimum detectable concentration--Required level of analytical detection for radiochemical samples.

Precision--The agreement among a set of individual measurements of the same property, usually under prescribed similar conditions. Precision is calculated by using relative percent difference of the duplicate/replicate analyses. These samples should contain concentrations of analyte above the MDL and may involve the use of matrix spikes.

Reliable detection level--A detection limit set at two times the concentration of the MDL, so the risk of both false positives and false negatives falls below 1%.

Type II reagent water--Distilled or deionized water that is free of contaminants that may interfere with the analytical test in question.

A.8 REFERENCES

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Figure A-1. Relationship of LOD and LOQ to Analyte Concentration.

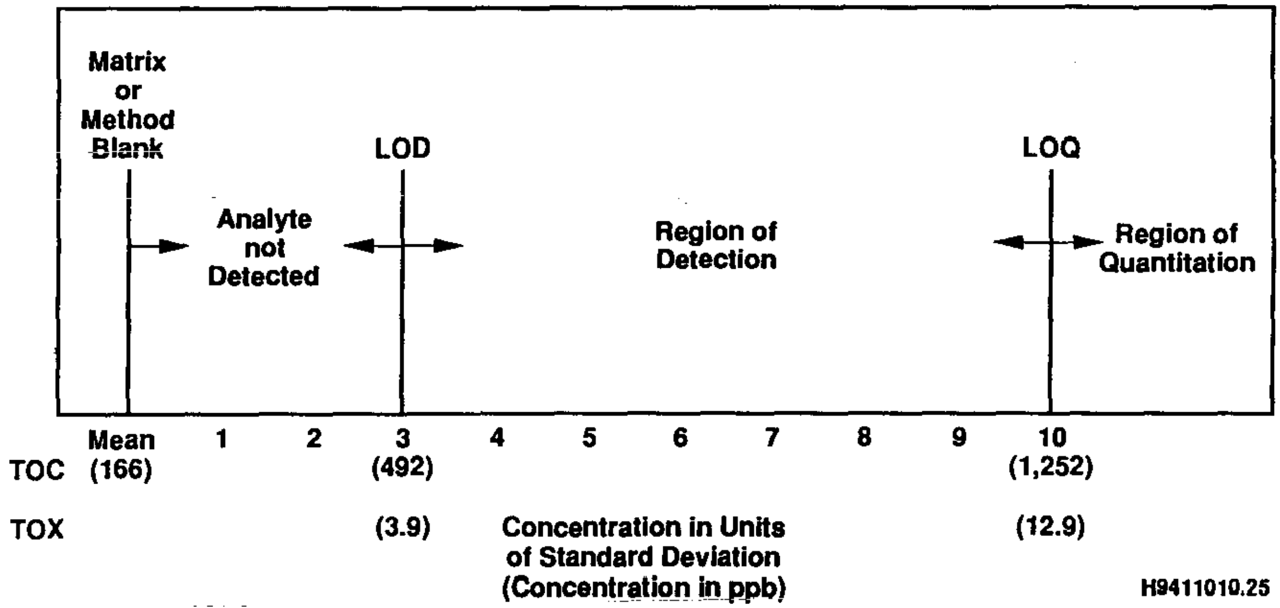

Table A-1. Summary of 1994 Quality Control Quarterly Reports.

Quarterly reports	Field duplicates (% acceptable)	Field blanks (% acceptable)
October-December 1993	97.2	98.4
January-March 1994	93.3	98.3
April-June 1994	93.9	96.2
July-September 1994	92.9	97.3

Table A-2. 1994 Field Blanks Exceeding Quality Control Limits. (2 sheets)

Method	Method name	Constituent name	Total analyses	Q Flags	Out of limits %
122	SW-846 9060	Total organic carbon	154	6	3.9
124	ASTM D-4327-88	Chloride	47	2	4.3
124	ASTM D-4327-88	Fluoride	47	1	2.1
124	ASTM D-4327-88	Nitrate	45	1	2.2
124	ASTM D-4327-88	Nitrite	47	1	2.1
124	ASTM D-4327-88	Sulfate	47	2	4.3
126	Std Meth #214A	Turbidity	39	38	97.4
127	ASTM D-2579-A	Total carbon	7	4	57.1
129	ASTM D-1426-C	Ammonium ion	20	7	35.0
135	SW-846 9310, Alpha	Gross alpha	45	1	2.2
141	ITAS Sr-90	Strontium-90	11	1	9.1
16	SW-846 8240	1,1,1-Trichloroethane	340	14	4.1
16	SW-846 8240	Acetone	339	1	.3
16	SW-846 8240	Benzene	346	1	.3
16	SW-846 8240	Carbon disulfide	342	6	1.8
16	SW-846 8240	Carbon tetrachloride	345	1	.3
16	SW-846 8240	Chloroform	346	7	2.0
16	SW-846 8240	Methylene chloride	346	107	30.9
16	SW-846 8240	Tetrahydrofuran	346	1	.3
16	SW-846 8240	Toluene	346	1	.3
19	SW-846 8270	2-Methylphenol	21	1	4.8
25	SW-846 8010/8020	Carbon tetrachloride	23	2	8.7
30	SW-846 8040	2,4,6-Trichlorophenol	33	1	3.0
30	SW-846 8040	2,4-Dichlorophenol	33	1	3.0
30	SW-846 8040	2,4-Dimethylphenol	33	1	3.0
30	SW-846 8040	2-Chlorophenol	33	1	3.0
30	SW-846 8040	2-Nitrophenol	33	1	3.0
30	SW-846 8040	4,6-Dinitro-2-methylpheno	33	1	3.0
30	SW-846 8040	4-Chloro-3-methylphenol	33	1	3.0

Table A-2. 1994 Field Blanks Exceeding Quality Control Limits. (2 sheets)

Method	Method name	Constituent name	Total analyses	Q Flags	Out of limits %
30	SW-846 8040	4-Nitrophenol	33	1	3.0
30	SW-846 8040	Phenol	33	3	9.1
30	SW-846 8040	Trichlorophenols	33	1	3.0
34	SW-846 6010	Aluminum	114	3	2.6
34	SW-846 6010	Barium	107	8	7.5
34	SW-846 6010	Cadmium	115	1	.9
34	SW-846 6010	Calcium	106	14	13.2
34	SW-846 6010	Chromium	115	3	2.6
34	SW-846 6010	Cobalt	113	2	1.8
34	SW-846 6010	Copper	113	2	1.8
34	SW-846 6010	Iron	113	9	8.0
34	SW-846 6010	Magnesium	115	2	1.7
34	SW-846 6010	Manganese	113	2	1.8
34	SW-846 6010	Nickel	115	1	.9
34	SW-846 6010	Potassium	115	1	.9
34	SW-846 6010	Sodium	106	15	14.2
34	SW-846 6010	Tin	114	4	3.5
34	SW-846 6010	Zinc	111	7	6.3
357	EPA 600, 310.2	Alkalinity	12	2	16.7
40	SW-846 7421	Lead	39	1	2.6
41	SW-846 7470	Mercury	40	1	2.5
62	Inhouse ion chrom.	Perchlorate	4	1	25.0
65	Std Meth #209B	Total dissolved solids	19	2	10.5
67	SW-846 9020	Total organic halogen	51	1	2.0

Table A-3. 1994 Field Duplicates Exceeding Quality Control Limits. (2 sheets)

Method	Method name	Constituent name	Total analyses	Q Flags	Out of limits %
122	SW-846 9060	Total organic carbon	66	9	13.6
124	ASTM D-4327-88	Bromide	79	4	5.1
124	ASTM D-4327-88	Fluoride	79	8	10.1
124	ASTM D-4327-88	Nitrate	79	2	2.5
124	ASTM D-4327-88	Nitrite	79	4	5.1
126	Std Meth #214A	Turbidity	51	3	5.9
129	ASTM D-1426-C	Ammonium ion	20	4	20.0
135	SW-846 9310, Alpha	Gross alpha	43	23	53.5
136	SW-846 9310, Beta	Gross beta	44	14	31.8
137	SW-846 9315, Radium	Radium	16	4	25.0
140	ITAS Gamma Scan	Antimony-125	13	1	7.7
140	ITAS Gamma Scan	Cesium-137	13	2	15.4
140	ITAS Gamma Scan	Cobalt-60	13	6	46.2

Table A-3. 1994 Field Duplicates Exceeding Quality Control Limits. (2 sheets)

Method	Method name	Constituent name	Total analyses	Q Flags	Out of limits %
140	ITAS Gamma Scan	Ruthenium-106	13	2	15.4
141	ITAS Sr-90	Strontium-90	14	1	7.1
142	ITAS H-3	Tritium	43	2	4.7
148	ITAS Isotopic U	Uranium-234	4	1	25.0
148	ITAS Isotopic U	Uranium-235	4	4	100.0
148	ITAS Isotopic U	Uranium-238	4	1	25.0
16	SW-846 8240	1,1,1-Trichloroethane	16	2	12.5
16	SW-846 8240	Carbon disulfide	14	1	7.1
16	SW-846 8240	Methylene chloride	16	1	6.3
17	SW-846 8080	Delta-BHC	29	1	3.4
17	SW-846 8080	Endosulfan I	29	1	3.4
17	SW-846 8080	Heptachlor	29	1	3.4
17	SW-846 8080	gamma-BHC (Lindane)	29	1	3.4
25	SW-846 8010/8020	Carbon tetrachloride	31	3	9.7
25	SW-846 8010/8020	Ethylbenzene	31	2	6.5
25	SW-846 8010/8020	Methylene chloride	31	2	6.5
25	SW-846 8010/8020	Tetrachloroethene	31	5	16.1
25	SW-846 8010/8020	Toluene	31	2	6.5
25	SW-846 8010/8020	Trichloroethene	31	5	16.1
25	SW-846 8010/8020	Xylenes (total)	31	1	3.2
30	SW-846 8040	Phenol	38	2	5.3
34	SW-846 6010	Aluminum	116	8	6.9
34	SW-846 6010	Antimony	146	5	3.4
34	SW-846 6010	Barium	146	2	1.4
34	SW-846 6010	Beryllium	146	6	4.1
34	SW-846 6010	Chromium	146	13	8.9
34	SW-846 6010	Cobalt	146	2	1.4
34	SW-846 6010	Copper	146	21	14.4
34	SW-846 6010	Iron	146	31	21.2
34	SW-846 6010	Manganese	146	20	13.7
34	SW-846 6010	Nickel	146	16	11.0
34	SW-846 6010	Potassium	146	4	2.7
34	SW-846 6010	Silver	146	6	4.1
34	SW-846 6010	Sodium	146	2	1.4
34	SW-846 6010	Tin	146	7	4.8
34	SW-846 6010	Vanadium	146	10	6.8
34	SW-846 6010	Zinc	146	51	34.9
358	SW-846 9012	Cyanide	10	1	10.0
40	SW-846 7421	Lead	84	23	27.4
43	SW-846 7060	Arsenic	70	7	10.0
48	SW-846 7740	Selenium	72	4	5.6
65	Std Meth #209B	Total dissolved solids	12	1	8.3
67	SW-846 9020	Total organic halogen	60	15	25.0

Table A-4. Summary of 1994 Quality Control Semiannual and Quarterly Reports (in percent acceptable).

1994 Quarterly reports	Precision[a]	Accuracy[a]	EPA water pollution	EPA water supply	Radiochemical interlab comparison
Oct-Dec 1993	98.8	98.6	97.2	Samples not sent this quarter	100 (11/92 - 02/93)
Jan-Mar 1994	100	99.6	Not reported by lab	Not reported by lab	Not received
Apr-Jun 1994	100	98.2	97.7	Samples not sent this quarter	100 (03/93 - 05/93)
Jul-Sept 1994	97.8	98.0	Samples not sent this quarter	98.7	100 (06/93 - 08/93)

[a]These figures represent radiochemistry data.
EPA = U.S. Environmental Protection Agency.

Table A-5. Groundwater Field Blanks Data from DataChem Laboratories. Constituent: Total Organic Carbon.

Period from	Period to	Number of samples	Mean (ppb)	Standard deviation (ppb)	LOD[a] (ppb)	LOQ[a] (ppb)
10/26/93	12/28/93	35	190	46.0	328	650
01/06/94	03/25/94	42	187	146.2	626	1,649
04/12/94	06/30/94	36	120	103.4	430	1,154
07/06/94	08/09/94	14	159	99.4	457	1,152
Summary		127	166	108.6	492	1,252

[a]LOD equals the mean blank concentration plus 3 standard deviation and LOQ equals the mean blank concentration plus 10 standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-6. Groundwater Field Blanks Data from Roy F. Weston Laboratories. Constituent: Total Organic Halogen.

Period from	Period to	Number of samples	Mean (ppb)	Standard deviation (ppb)	LOD[a] (ppb)	LOQ[a] (ppb)
11/29/93	12/17/93	15	0.712	1.159	3.5	11.6
01/03/94	03/22/94	28	0.804	1.260	3.8	12.6
04/01/94	06/15/94	25	1.154	1.454	4.4	14.5
07/01/94	08/08/94	13	0.828	1.162	3.5	11.6
Summary		81	0.899	1.292	3.9	12.9

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-7. Groundwater Field Blanks Data from IT Analytical Services. Constituent: Antimony-125.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
10/08/93	12/13/93	3	-0.280	2.167	6.50	21.67
05/24/94	06/15/94	3	-8.490	12.710	38.13	127.10
08/23/94	09/20/94	4	-3.153	7.563	22.69	75.63
Summary		10	-3.892	8.486	25.46	84.86

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-8. Groundwater Field Blanks Data from IT Analytical Services. Constituent: Cesium-137.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
10/08/93	12/13/93	3	-1.627	2.465	7.40	24.65
05/24/94	06/15/94	3	0.673	1.553	4.66	15.53
08/23/94	09/20/94	4	-2.017	4.281	12.84	42.81
Summary		10	-1.093	3.206	9.62	32.06

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-9. Groundwater Field Blanks Data from IT Analytical Services. Constituent: Cobalt-60.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
10/08/93	12/13/93	3	4.917	2.480	7.44	24.80
05/24/94	06/15/94	3	-1.687	0.551	1.65	5.51
08/23/94	09/20/94	4	-0.640	5.148	15.44	51.48
Summary		10	0.713	3.633	10.90	36.33

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-10. Groundwater Field Blanks Data from IT Analytical Services. Constituent: Gross Alpha.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
10/06/93	12/17/93	13	0.005	0.182	0.54	1.82
01/03/94	03/22/94	14	0.056	0.212	0.64	2.12
04/01/94	06/08/94	8	-0.006	0.185	0.56	1.85
07/01/94	09/20/94	10[b]	-0.020	0.182	0.55	1.82
Summary		45	0.024	0.192	0.58	1.92

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
[b]Excluding FTR #221 because of it had blank contamination.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-11. Groundwater Field Blanks Data from IT Analytical Services. Constituent: Gross Beta.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
10/06/93	12/17/93	13	0.640	1.352	4.06	13.52
01/03/94	03/22/94	14	0.057	1.025	3.08	10.25
04/01/94	06/08/94	8	0.425	0.769	2.31	7.69
07/01/94	09/20/94	11	0.302	1.358	4.08	13.58
Summary		46	0.344	1.177	3.53	11.77

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-12. Groundwater Field Blanks Data from IT Analytical Services.
Constituent: Iodine-129.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
11/04/93	09/20/94	7	-0.045	0.257	0.77	2.57

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-13. Groundwater Field Blanks Data from IT Analytical Services.
Constituent: Plutonium-238.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
12/10/93	09/20/94	5	0.0010	0.0059	0.0176	0.0588

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-14. Groundwater Field Blanks Data from IT Analytical Services.
Constituent: Plutonium-239/240.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
12/10/93	09/20/94	5	0.0004	0.0037	0.0112	0.0373

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-15. Groundwater Field Blanks Data from IT Analytical Services. Constituent: Radium.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
10/11/93	11/29/93	5	-0.018	0.0324	0.097	0.324
01/04/94	03/22/94	5	-0.006	0.0237	0.071	0.237
04/22/94	05/24/94	3	0.023	0.0295	0.089	0.295
07/21/94	08/23/94	2	-0.000	0.0586	0.176	0.586
Summary		15	-0.004	0.0325	0.098	0.325

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-16. Groundwater Field Blanks Data from IT Analytical Services. Constituent: Strontium-90.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
11/11/93	12/10/93	2	0.328	0.443	1.330	4.434
03/14/94	03/17/94	2	-0.056	0.049	0.148	0.493
05/24/94	06/30/94	2	-0.063	0.034	0.102	0.341
09/07/94	09/20/94	4[b]	-0.119	0.052	0.156	0.521
Summary		10	-0.006	0.186	0.558	1.860

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
[b]Excluding FTR #219 because of it had blank contamination.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-17. Groundwater Field Blanks Data from IT Analytical Services. Constituent: Technetium-99.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
10/06/93	12/17/93	4	0.563	0.701	2.104	7.013
01/03/94	03/17/94	3	-0.202	0.499	1.498	4.992
04/01/94	06/30/94	2	-0.180	0.810	2.431	8.103
07/13/94	09/20/94	2	0.606	0.770	2.309	7.700
Summary		11	0.227	0.679	2.037	6.790

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-18. Groundwater Field Blanks Data from IT Analytical Services. Constituent: Tritium.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
10/08/93	12/17/93	13	90.29	83.649	250.95	836.49
01/04/94	03/22/94	14	84.54	96.769	290.31	967.68
04/18/94	06/15/94	9	91.92	102.900	308.70	1029.00
07/01/94	09/20/94	12	63.97	176.802	530.41	1768.02
Summary		48	82.34	120.06	360.2	1200.6

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-19. Groundwater Field Blanks Data from IT Analytical Services.
Constituent: Uranium.

Period from	Period to	Number of samples	Mean (pCi/L)	Standard deviation (pCi/L)	LOD[a] (pCi/L)	LOQ[a] (pCi/L)
10/06/93	12/17/93	5	0.032	0.0274	0.082	0.274
01/03/94	03/22/94	7	0.056	0.0567	0.170	0.567
04/01/94	06/07/94	4	0.002	0.0204	0.061	0.204
07/01/94	09/20/94	6	-0.004	0.0200	0.060	0.200
Summary		22	0.024	0.0377	0.113	0.377

[a]LOD (blank corrected) equals 3 times the blank standard deviation and LOQ (blank corrected) equals 10 times the blank standard deviation.
LOD = limit of detection.
LOQ = limit of quantitation.

Table A-20. LOD and LOQ Calculations for Selected Constituents Based on MDL Report[a,b] for LOW Level Standards. (8 sheets)

Method name	Name	Standard deviation	MDL	LOD	LOQ
ASTM D-2579-A	Total carbon	34.550384	108.4882	146.5845	488.615
SW-846 6010	Aluminum	8.0647885	25.32344	34.21591	114.053
SW-846 6010	Antimony	19.520829	61.2954	82.81965	276.0655
SW-846 6010	Barium	0.01065808	0.033466	0.045218	0.150728
SW-846 6010	Beryllium	0.1898242	0.596048	0.805354	2.684513
SW-846 6010	Cadmium	1.0323903	3.241706	4.38005	14.60017
SW-846 6010	Calcium	10.778231	33.84365	45.72805	152.4268
SW-846 6010	Chromium	1.8551392	5.825137	7.870669	26.23556
SW-846 6010	Cobalt	1.2760285	4.006729	5.413717	18.04572
SW-846 6010	Copper	3.2278278	10.13538	13.69448	45.64826
SW-846 6010	Iron	7.2568388	22.78647	30.78808	102.6269
SW-846 6010	Magnesium	0.2282026	0.716556	0.968179	3.227264
SW-846 7060	Arsenic	0.8625709	2.708473	3.659569	12.19856
SW-846 7421	Lead	0.4627609	1.453069	1.963323	6.544411
SW-846 7470	Mercury	0.016	0.05024	0.067882	0.226274
SW-846 7740	Selenium	0.2060629	0.647038	0.874249	2.914162
SW-846 7841	Thallium	0.1816983	0.570533	0.770879	2.569596
SW-846 8010/ 8020	1,1,1-Trichloroethane	0.0114	0.035796	0.048366	0.16122
SW-846 8010/ 8020	1,1,2-Trichloroethane	0.0246	0.077244	0.104369	0.347896
SW-846 8010/ 8020	1,1-Dichloroethane	0.01837	0.057682	0.077937	0.25979
SW-846 8010/ 8020	1,2-Dichloroethane	0.00896	0.028134	0.038014	0.126713
SW-846 8010/ 8020	Benzene	0.0039	0.012246	0.016546	0.055154
SW-846 8010/ 8020	Carbon tetrachloride	0.02364	0.07423	0.100296	0.334319
SW-846 8010/ 8020	Chloroform	0.01288	0.040443	0.054645	0.18215
SW-846 8010/ 8020	Ethylbenzene	0.01694	0.053192	0.07187	0.239567
SW-846 8010/ 8020	Toluene	0.00482	0.015135	0.020449	0.068165
SW-846 8010/ 8020	Tetrachloroethene	0.06727	0.211228	0.285402	0.951339
SW-846 8010/ 8020	Trichloroethene	0.1019	0.319966	0.432324	1.44108
SW-846 8010/ 8020	Vinyl chloride	0.0386	0.121204	0.163766	0.545885

Table A-20. LOD and LOQ Calculations for Selected Constituents Based on MDL Report[a,b] for LOW Level Standards. (8 sheets)

Method name	Name	Standard deviation	MDL	LOD	LOQ
SW-846 8010/ 8020	Vinyl chloride	0.0386	0.121204	0.163766	0.545885
SW-846 8010/ 8020	Xylenes (total)	0.01083	0.034006	0.045948	0.153159
SW-846 8021	Benzene	0.0039	0.012246	0.016546	0.055154
SW-846 8021	Carbon tetrachloride	0.02364	0.07423	0.100296	0.334319
SW-846 8021	Chloroform	0.01288	0.040443	0.054645	0.18215
SW-846 8021	1,1-Dichloroethane	0.01837	0.057682	0.077937	0.25979
SW-846 8021	1,2-Dichloroethane	0.00896	0.028134	0.038014	0.126713
SW-846 8021	Ethylbenzene	0.01694	0.053192	0.07187	0.239567
SW-846 8021	Toluene	0.00482	0.015135	0.020449	0.068165
SW-846 8021	1,1,1-Trichloroethane	0.0114	0.035796	0.048366	0.16122
SW-846 8021	1,1,2-Trichloroethane	0.0246	0.077244	0.104369	0.347896
SW-846 8021	Vinyl chloride	0.0386	0.121204	0.163766	0.545885
SW-846 8040	2,4,6-Trichlorophenol	0.409	1.28426	1.735236	5.784119
SW-846 8040	2,4-Dichlorophenol	0.394	1.23716	1.671596	5.571987
SW-846 8040	2,4-Dimethylphenol	0.381	1.19634	1.616442	5.38814
SW-846 8040	2,4-Dinitrophenol	0.933	2.92962	3.958374	13.19458
SW-846 8040	2,6-Dichlorophenol	0.427	1.34078	1.811603	6.038677
SW-846 8040	2-Chlorophenol	0.481	1.51034	2.040705	6.80235
W-846 8040	2-Nitrophenol	0.413	1.29682	1.752206	5.840687
SW-846 8040	4-Chloro-3-methylphenol	0.408	1.28112	1.730993	5.769977
SW-846 8040	2-Methyl-4, 6-dinitrophenol	0.248	0.77872	1.052172	3.507241
SW-846 8040	4-Nitrophenol	0.927	2.91078	3.932918	13.10973
SW-846 8040	Cresols	1.515	4.7571	6.427584	21.42528
SW-846 8040	Pentachlorophenol	0.391	1.22774	1.658868	5.529561
SW-846 8040	Phenol	0.521	1.63594	2.21041	7.368034
SW-846 8040	Tetrachlorophenols	0.467	1.46638	1.981308	6.604361
SW-846 8080	Aldrin	0.000845	0.002653	0.003585	0.01195
SW-846 8080	Dieldrin	0.000439	0.001378	0.001863	0.006208
SW-846 8080	Endosulfan I	0.0004309	0.001353	0.001828	0.006094
SW-846 8080	Endosulfan II	0.0003603	0.001131	0.001529	0.005095
SW-846 8080	Endosulfan sulfate	0.0006903	0.002168	0.002929	0.009762
SW-846 8080	Endrin	0.000357	0.001121	0.001515	0.005049
SW-846 8080	Endrin aldehyde	0.0005668	0.00178	0.002405	0.008016
SW-846 8080	Heptachlor epoxide	0.0004051	0.001272	0.001719	0.005729

Table A-20. LOD and LOQ Calculations for Selected Constituents Based on MDL Report[a,b] for LOW Level Standards. (8 sheets)

Method name	Name	Standard deviation	MDL	LOD	LOQ
SW-846 8080	Gamma-BHC (lindane)	0.0004086	0.001283	0.001734	0.005778
SW-846 8080	Methoxychlor	0.0050356	0.015812	0.021364	0.071214
SW-846 8080	Aroclor 1016	0.0227701	0.071498	0.096605	0.322017
SW-846 8080	Aroclor 1221	0.0172994	0.05432	0.073395	0.24465
SW-846 8080	Aroclor 1232	0.0307896	0.096679	0.130629	0.43543
SW-846 8080	Aroclor 1242	0.0223862	0.070293	0.094976	0.316588
SW-846 8080	Aroclor 1248	0.0174719	0.054862	0.074127	0.247089
SW-846 8080	Aroclor 1254	0.010306	0.032361	0.043725	0.145748
SW-846 8080	Aroclor 1260	0.0181973	0.05714	0.077204	0.257348
SW-846 8140	Disulfoton	0.021155	0.066427	0.089753	0.299176
SW-846 8140	Methyl parathion	0.046617	0.146377	0.197779	0.659262
SW-846 8140	Phorate	0.017606	0.055283	0.074696	0.248986
SW-846 8240	1,1,2-Trichloroethane	0.0362284	0.113757	0.153704	0.512346
SW-846 8240	1,1,1-Trichloroethane	0.4158554	1.305786	1.764321	5.881069
SW-846 8240	1,1-Dichloroethane	0.0494734	0.155346	0.209897	0.699658
SW-846 8240	1,2-Dichloroethane	0.0728501	0.228749	0.309076	1.030253
SW-846 8240	1,4-Dichlorobenzene	0.1224672	0.384547	0.519583	1.731943
SW-846 8240	Acetone	1.4362296	4.509761	6.093391	20.3113
SW-846 8240	Acetonitrile	9.182344	28.83256	38.95729	129.8576
SW-846 8240	Acrolein	1.7606411	5.528413	7.469749	24.89916
SW-846 8240	Acrylonitrile	0.3176673	0.997475	1.347745	4.492483
SW-846 8240	Allyl chloride	0.0779079	0.244631	0.330534	1.101781
SW-846 8240	Bromodichloromethane	0.0508031	0.159522	0.215539	0.718463
SW-846 8240	Bromoform	0.0576525	0.181029	0.244598	0.815327
SW-846 8240	Benzene	0.0775403	0.243477	0.328975	1.096583
SW-846 8240	Carbon disulfide	0.0512231	0.160841	0.217321	0.724402
SW-846 8240	Carbon tetrachloride	0.0539841	0.16951	0.229035	0.763449
SW-846 8240	Chlorobenzene	0.106066	0.333047	0.449999	1.499996
SW-846 8240	Chloroethane	0.0994748	0.312351	0.422035	1.406783
SW-846 8240	1,2-Dibromo-3-Chloropropane	0.1907832	0.599059	0.809423	2.698075
SW-846 8240	1,2-Dibromoethane	0.0183225	0.057533	0.077736	0.259119
SW-846 8240	Trans-1,4-Dichloro-1-Butene	0.115305	0.362058	0.489196	1.630655
SW-846 8240	Dichlorodifluoromethane	0.0381491	0.119788	0.161853	0.539508
SW-846 8240	1,2-Dichloropropane	0.036645	0.115065	0.155471	0.518237
SW-846 8240	Cis-1,3-Dichloropropene	0.0579819	0.182063	0.245996	0.819986

Table A-20. LOD and LOQ Calculations for Selected Constituents Based on MDL Report[a,b] for LOW Level Standards. (8 sheets)

Method name	Name	Standard deviation	MDL	LOD	LOQ
SW-846 8240	1,4-Dioxane	11.792277	37.02775	50.03027	166.7676
SW-846 8240	Ethyl methacrylate	0.0175255	0.05503	0.074354	0.247847
SW-846 8240	2-Hexanone	0.2193456	0.688745	0.930602	3.102007
SW-846 8240	Isobutyl alcohol	3.4220063	10.7451	14.51831	48.39436
SW-846 8240	Pentachloroethane	0.4656006	1.461986	1.975371	6.58457
SW-846 8240	Styrene	0.0540723	0.169787	0.229409	0.764696
SW-846 8240	1,1,1,2-Tetrachloroethane	0.0301188	0.094573	0.127783	0.425943
SW-846 8240	1,1,2,2-Tetrachloroethane	0.1028175	0.322847	0.436217	1.454055
SW-846 8240	Trichlorofluoromethane	0.0668554	0.209926	0.283643	0.945476
SW-846 8240	1,2,3-Trichloropropane	0.0286606	0.089994	0.121596	0.405321
SW-846 8240	Vinyl acetate	0.2295804	0.720882	0.974025	3.246749
SW-846 8240	Chlorprene	0.070677	0.221926	0.299856	0.999521
SW-846 8240	Methyl methacrylate	0.1007827	0.316458	0.427584	1.425279
SW-846 8240	4-Methyl-2-Pentanone	0.4756875	1.493659	2.018166	6.72722
SW-846 8240	Ethylbenzene	0.0993311	0.3119	0.421425	1.40475
SW-846 8240	Methylene chloride	0.0499524	0.156851	0.21193	0.706432
SW-846 8240	Methacrylonitrile	0.1116329	0.350527	0.473617	1.578724
SW-846 8240	Tetrahydrofuran	0.8009002	2.514827	3.397923	11.32641
SW-846 8240	Vinyl chloride	0.0373927	0.117413	0.158643	0.528811
SW-846 8240	Xylene (total)	0.0395511	0.12419	0.167801	0.559336
SW-846 8240	1-Butanol	11.402422	35.80361	48.37626	161.2542
SW-846 8240	Propionitrile	0.8453866	2.654514	3.586663	11.95554
SW-846 8240	Toluene	0.0948181	0.297729	0.402278	1.340927
SW-846 8240	Trichloroethene	0.1054243	0.331032	0.447276	1.490921
SW-846 8260	Acetone	1.2511794	3.928703	5.308291	17.6943
SW-846 8260	Acetonitrile	17.576952	55.19163	74.5725	248.575
SW-846 8260	Acrolein	2.1093584	6.623385	8.949227	29.83076
SW-846 8260	Acrylonitrile	0.2203731	0.691972	0.934962	3.116538
SW-846 8260	Allyl chloride	0.0992742	0.311721	0.421184	1.403946
SW-846 8260	Bromodichloromethane	0.0430739	0.135252	0.182747	0.609155
SW-846 8260	Bromoform	0.0383359	0.120375	0.162645	0.54215
SW-846 8260	Chlorobenzene	0.045336	0.142355	0.192344	0.641146
SW-846 8260	Chloroethane	0.0906327	0.284587	0.384521	1.281737
SW-846 8260	Dibromochloromethane	0.0206588	0.064869	0.087648	0.292159
SW-846 8260	1,2-Dibromo-3-Chloropropane	0.1572475	0.493757	0.667143	2.22381

Table A-20. LOD and LOQ Calculations for Selected Constituents Based on MDL Report[a,b] for LOW Level Standards. (8 sheets)

Method name	Name	Standard deviation	MDL	LOD	LOQ
SW-846 8260	1,2-Dibromothane	0.0480327	0.150823	0.203785	0.679283
SW-846 8260	Trans-1,4-Dichloro-2-Butene	0.1305415	0.4099	0.553839	1.846131
SW-846 8260	Dichlorodifluoromethane	0.2791697	0.876593	1.184414	3.948046
SW-846 8260	1,2-Dichloropropane	0.0435685	0.136805	0.184845	0.61615
SW-846 8260	Cis-1,3-Dichloropropene	0.0380789	0.119568	0.161555	0.538516
SW-846 8260	Trans-1,3-Dichloropropene	0.0324863	0.102007	0.137827	0.459425
SW-846 8260	1,4-Dioxane	52.173887	163.826	221.3545	737.8483
SW-846 8260	Ethylbenzene	0.0650137	0.204143	0.275829	0.91943
SW-846 8260	Ethyl methacrylate	0.0920792	0.289129	0.390658	1.302193
SW-846 8260	2-Hexanone	0.0883883	0.277539	0.374999	1.249996
SW-846 8260	Isobutyl alcohol	0.9829175	3.086361	4.170155	13.90052
SW-846 8260	Methacrylonitrile	0.0671884	0.210972	0.285056	0.950185
SW-846 8260	Pentachloroethane	0.2323175	0.729477	0.985637	3.285457
SW-846 8260	Styrene	0.0360307	0.113136	0.152865	0.50955
SW-846 8260	1,1,1,2-Tetrachloroethane	0.0471573	0.148074	0.200071	0.666903
SW-846 8260	1,1,2,2-Tetrachloroethane	0.0471888	0.148173	0.200205	0.667349
SW-846 8260	Trichlorofluoromethane	0.1383577	0.434443	0.587001	1.956668
SW-846 8260	1,2,3-Trichloropropane	0.1040518	0.326723	0.441453	1.471511
SW-846 8260	Vinyl acetate	0.1230273	0.386306	0.521959	1.739864
SW-846 8260	Benzene	0.0417475	0.131087	0.177119	0.590397
SW-846 8260	Carbon tetrachloride	0.0945289	0.296821	0.401051	1.336837
SW-846 8260	Chloroform	0.0453557	0.142417	0.192427	0.641425
SW-846 8260	Chloroprene	0.1173111	0.368357	0.497708	1.659025
SW-846 8260	1,1-Dichloroethane	0.0555492	0.174424	0.235675	0.785582
SW-846 8260	1,2-Dichloroethane	0.0443203	0.139166	0.188035	0.626782
SW-846 8260	Methylene chloride	0.0559177	0.175582	0.237238	0.790794
SW-846 8260	Methyl methacrylate	0.0512522	0.160932	0.217444	0.724814
SW-846 8260	4-Methyl-2-Pentanone	0.0335676	0.105402	0.142415	0.474716
SW-846 8260	Tetrahydrofuran	0.4512522	1.416932	1.914496	6.381654
SW-846 8260	Toluene	0.0520817	0.163537	0.220963	0.736545
SW-846 8260	1,1,1-Trichloroethane	0.0772288	0.242498	0.327653	1.092177
SW-846 8260	1,1,2-Trichloroethane	0.0679154	0.213254	0.28814	0.960466
SW-846 8260	Vinyl chloride	0.0730949	0.229518	0.310115	1.033715
SW-846 8260	Total xylene	0.1232883	0.387125	0.523067	1.743555
SW-846 8260	1-Butanol	51.00109	160.1434	216.3788	721.2625

Table A-20. LOD and LOQ Calculations for Selected Constituents Based on MDL Report[a,b] for LOW Level Standards. (8 sheets)

Method name	Name	Standard deviation	MDL	LOD	LOQ
SW-846 8260	Propionitrile	0.4116322	1.292525	1.746403	5.821344
SW-846 8260	Carbon disulfide	0.1017613	0.31953	0.431736	1.439118
SW-846 8270	Acenaphthene	0.91	2.8574	3.860793	12.86931
SW-846 8270	Acenaphthylene	0.91	2.8574	3.860793	12.86931
SW-846 8270	Acetophenone	0.82	2.5748	3.478957	11.59652
SW-846 8270	2-Acetylaminofluorene	1.2	3.768	5.091156	16.97052
SW-846 8270	4-Aminobiphenyl	0.67	2.1038	2.842562	9.475207
SW-846 8270	Aniline	1.06	3.3284	4.497188	14.99063
SW-846 8270	Anthracene	1.1	3.454	4.666893	15.55631
SW-846 8270	Aramite	0.68	2.1352	2.884988	9.616628
SW-846 8270	Benzo(a)anthracene	0.04	0.1256	0.169705	0.565684
SW-846 8270	Benzo(b)fluoranthene	0.59	1.8526	2.503152	8.343839
SW-846 8270	Benzo(k)fluoranthene	0.89	2.7946	3.775941	12.58647
SW-846 8270	Benzo(ghi)perylene	1	3.14	4.24263	14.1421
SW-846 8270	Benzyl alcohol	0.81	2.5434	3.43653	11.4551
SW-846 8270	Bis (2-chloroethyl) ether	1.67	5.2438	7.085192	23.61731
SW-846 8270	Bis (2-chloroethoxy)-methane	0.94	2.9516	3.988072	13.29357
SW-846 8270	Chlorobenzilate	1.34	4.2076	5.685124	18.95041
SW-846 8270	2-Chlorophenol	1.23	3.8622	5.218435	17.39478
SW-846 8270	Chrysene	0.16	0.5024	0.678821	2.262736
SW-846 8270	Diallate	0.32	1.0048	1.357642	4.525472
SW-846 8270	Dibenzofuran	2.06	6.4684	8.739818	29.13273
SW-846 8270	Di-n-butylphthalate	1.75	5.495	7.424603	24.74868
SW-846 8270	3,3'-Dichlorobenzidine	0.95	2.983	4.030499	13.435
SW-846 8270	2,6-Dichlorophenol	1.76	5.5264	7.467029	24.8901
SW-846 8270	Diethyl phthalate	2.11	6.6254	8.951949	29.83983
SW-846 8270	3,3'-Dimethylbenzidine	1.59	4.9926	6.745782	22.48594
SW-846 8270	alpha,alpha-Dimethylphenethylamine	2.13	6.6882	9.036802	30.12267
SW-846 8270	2,4-Dimethylphenol	1.81	5.6834	7.67916	25.5972
SW-846 8270	2,4-Dinitrophenol	7.99	25.0886	33.89861	112.9954
SW-846 8270	Di-n-octyl phthalate	0.06	0.1884	0.254558	0.848526
SW-846 8270	Diphenylamine	0.83	2.6062	3.521383	11.73794
SW-846 8270	Ethyl methanesulfonate	0.86	2.7004	3.648662	12.16221
SW-846 8270	Famphur	0.37	1.1618	1.569773	5.232577
SW-846 8270	Fluoranthene	1.24	3.8936	5.260861	17.5362

Table A-20. LOD and LOQ Calculations for Selected Constituents Based on MDL Report[a,b] for LOW Level Standards. (8 sheets)

Method name	Name	Standard deviation	MDL	LOD	LOQ
SW-846 8270	Fluorene	1.07	3.3598	4.539614	15.13205
SW-846 8270	Hexachlorobenzene	0.78	2.4492	3.309251	11.03084
SW-846 8270	Hexachlorobutadiene	0.79	2.4806	3.351678	11.17226
SW-846 8270	Hexachlorocyclopentadiene	1.43	4.4902	6.066961	20.2232
SW-846 8270	Hexachloroethane	1.04	3.2656	4.412335	14.70778
SW-846 8270	Hexachloropropene	0.39	1.2246	1.654626	5.515419
SW-846 8270	Indeno(1,2,3-cd)pyrene	2.83	8.8862	12.00664	40.02214
SW-846 8270	Isodrin	0.73	2.2922	3.09712	10.32373
SW-846 8270	Isophorone	1.58	4.9612	6.703355	22.34452
SW-846 8270	Isasafrole	0.91	2.8574	3.860793	12.86931
SW-846 8270	Kepone	0.81	2.5434	3.43653	11.4551
SW-846 8270	Methapyrilene	1.28	4.0192	5.430566	18.10189
SW-846 8270	3-Methylcholanthrene	0.82	2.5748	3.478957	11.59652
SW-846 8270	Methyl methane sulfonate	0.75	2.355	3.181973	10.60658
SW-846 8270	2-Methylnaphthalene	1.73	5.4322	7.33975	24.46583
SW-846 8270	1-Naphthylamine	0.87	2.7318	3.691088	12.30363
SW-846 8270	2-Naphthylamine	0.69	2.1666	2.927415	9.758049
SW-846 8270	Nitrobenzene	1.5	4.71	6.363945	21.21315
SW-846 8270	4-Nitroquinoline-1-oxide	6.76	21.2264	28.68018	95.6006
SW-846 8270	N-nitrosodi-n-butylamine	1.67	5.2438	7.085192	23.61731
SW-846 8270	N-nitrosodiethylamine	1.81	5.6834	7.67916	25.5972
SW-846 8270	N-nitrosodimethylamine	1.46	4.5844	6.19424	20.64747
SW-846 8270	N-nitrosodiphenylamine	0.04	0.1256	0.169705	0.565684
SW-846 8270	N-nitrosodipropylamine; di-n-propylnitrosamine	2.69	8.4466	11.41267	38.04225
SW-846 8270	N-nitrosomorpholine	1.4	4.396	5.939682	19.79894
SW-846 8270	N-nitrosopiperidine	1.26	3.9564	5.345714	17.81905
SW-846 8270	N-nitrosopyrrolidine	1.92	6.0288	8.14585	27.15283
SW-846 8270	5-Nitro-o-toluidine	0.7	2.198	2.969841	9.89947
SW-846 8270	Parathion	1.12	3.5168	4.751746	15.83915
SW-846 8270	Pentachloronitrobenzene	0.75	2.355	3.181973	10.60658
SW-846 8270	Phenacetin	1.06	3.3284	4.497188	14.99063
SW-846 8270	Phenanthrene	0.96	3.0144	4.072925	13.57642
SW-846 8270	Pronamide	0.05	0.157	0.212132	0.707105
SW-846 8270	Pyrene	0.53	1.6642	2.248594	7.495313

Table A-20. LOD and LOQ Calculations for Selected Constituents Based on MDL Report[a,b] for LOW Level Standards. (8 sheets)

Method name	Name	Standard deviation	MDL	LOD	LOQ
SW-846 8270	1,2,4,5-Tetrachlorobenzene	0.36	1.1304	1.527347	5.091156
SW-846 8270	2,3,4,6-Tetrachlorophenol	2.26	7.0964	9.588344	31.96115
SW-846 8270	Tetraethyl dithiopyrophosphate	1.12	3.5168	4.751746	15.83915
SW-846 8270	o-Toluidine	1.18	3.7052	5.006303	16.68768
SW-846 8270	1,2,4-Trichlorobenzene	0.86	2.7004	3.648662	12.16221
SW-846 8270	2,4,5-Trichlorophenol	0.56	1.7584	2.375873	7.919576
SW-846 8270	2,4,6-Trichlorophenol	0.74	2.3236	3.139546	10.46515
SW-846 8270	o,o,o-Triethyl phosphorothioate	1.15	3.611	4.879025	16.26342
SW-846 8270	sym-Trinitrobenzene	1.28	4.0192	5.430566	18.10189
SW-846 8270	Benzothiazole	0.39	1.2246	1.654626	5.515419
SW-846 8270	Bis(2-Ethylhexyl)Phthalate	1.66	5.2124	7.042766	23.47589
SW-846 8270	Decane	0.6	1.884	2.545578	8.48526
SW-846 8270	Dodecane	0.35	1.099	1.484921	4.949735
SW-846 8270	Kerosene	1.06	3.3284	4.497188	14.99063
SW-846 8270	Tetradecane	0.49	1.5386	2.078889	6.929629
SW-846 8270	2-Nitrophenol	0.58	1.8212	2.460725	8.202418
SW-846 8270	Phenol	0.17	0.5338	0.721247	2.404157
SW-846 8270	Tris-2-chloroethyl phosphate	0.19	0.5966	0.8061	2.686999
SW-846 9030	Sulfide	64.5689	202.7463	273.942	913.1398
SW-846 9060	Total organic carbon	33.534907	105.2996	142.2762	474.254

[a]Based on MDL report for May through July 1994. MDLs are based on seven replicates of low-level standards by the same analyst on the same day.
[b]Units are in parts per billion (ppb).
LOD = limit of detection.
LOQ = limit of quantitation.
MDL = method of detection.

APPENDIX B

DATA EVALUATION

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B.0 DATA EVALUATION

R. V. Gray
Westinghouse Hanford Company

Data evaluation is a process through which suspect data are identified and investigated. At present, the data evaluation process consists of the investigation of requests for data evaluation (RADE) and the statistical evaluation of contamination indicator parameter data.

The evaluation of RADEs are discussed in the following section. The statistical evaluation of contamination indicator parameters is discussed in the site-specific chapters and Appendix C.

B.1 REQUEST FOR ANALYTICAL DATA EVALUATION PROCEDURE

Suspect data called out in RADEs are evaluated in terms of the following (WHC-CM-7-8):

- Review trend of historical data for the well in question
- Examination of contaminant distributions (e.g., plumes) that may affect concentrations in the well in question
- Results of quality control samples that may affect the data in question
- Laboratory data (e.g., chemist sheets) for the data in question
- Internal consistencies between replicated analyses.

As a result of the RADEs, the data in question may be:

- Determined to be in error and corrected
- Viewed as acceptable, resulting in a G flag
- Viewed as suspect data, resulting in a Y flag
- Viewed as rejected data, resulting in an R flag.

B.2 REQUESTS FOR ANALYTICAL DATA EVALUATION

A total of 93 RADEs were submitted for samples collected during October 1993 through September 1994. The RADEs submitted involved most of the major analytical groups; however, approximately 90% of the total was accounted for by the following five constituent groups: (1) pH and conductivity measurements performed in the field, (2) inductively coupled plasma metals, (3) radionuclides, (4) total organic halogen, and (5) anions (Figure B-1).

B.2.1 Field Measurements

Twenty-nine RADEs involve measurements of pH and conductivity made by field samplers. These RADEs reflect values that are unusually higher or lower than historical trends and/or critical means/ranges for a particular well. This represents a long-term recurrent problem with field calibration and measurement. The values are usually flagged as suspect data unless hard evidence is available to flag the data as rejected, such as when lab measurements made during the same sampling event confirmed that field measurements were in error.

B.2.2 Inductively Coupled Plasma Metals

Twenty-two RADEs were submitted for inductively coupled plasma metals. There does not appear to be a systematic error, so evaluation for many of them will depend on laboratory records.

B.2.3 Radionuclides

Fourteen RADEs were submitted concerning radionuclide analysis. These RADEs seem to represent a random collection of out-of-range data and do not indicate systematic problems with the analyses.

B.2.4 Total Organic Halogen

This constituent group received 12 RADEs. The RADEs for total organic halogen appear for the most part to be the result of laboratory problems. Many involve quadruplicate samples that do not agree. The others usually exceed historical trends. The fliers are usually flagged as suspect.

B.2.5 Anions

Eight RADEs were submitted for anions. There does not appear to be a systematic error, so evaluation for many of them will depend on laboratory records.

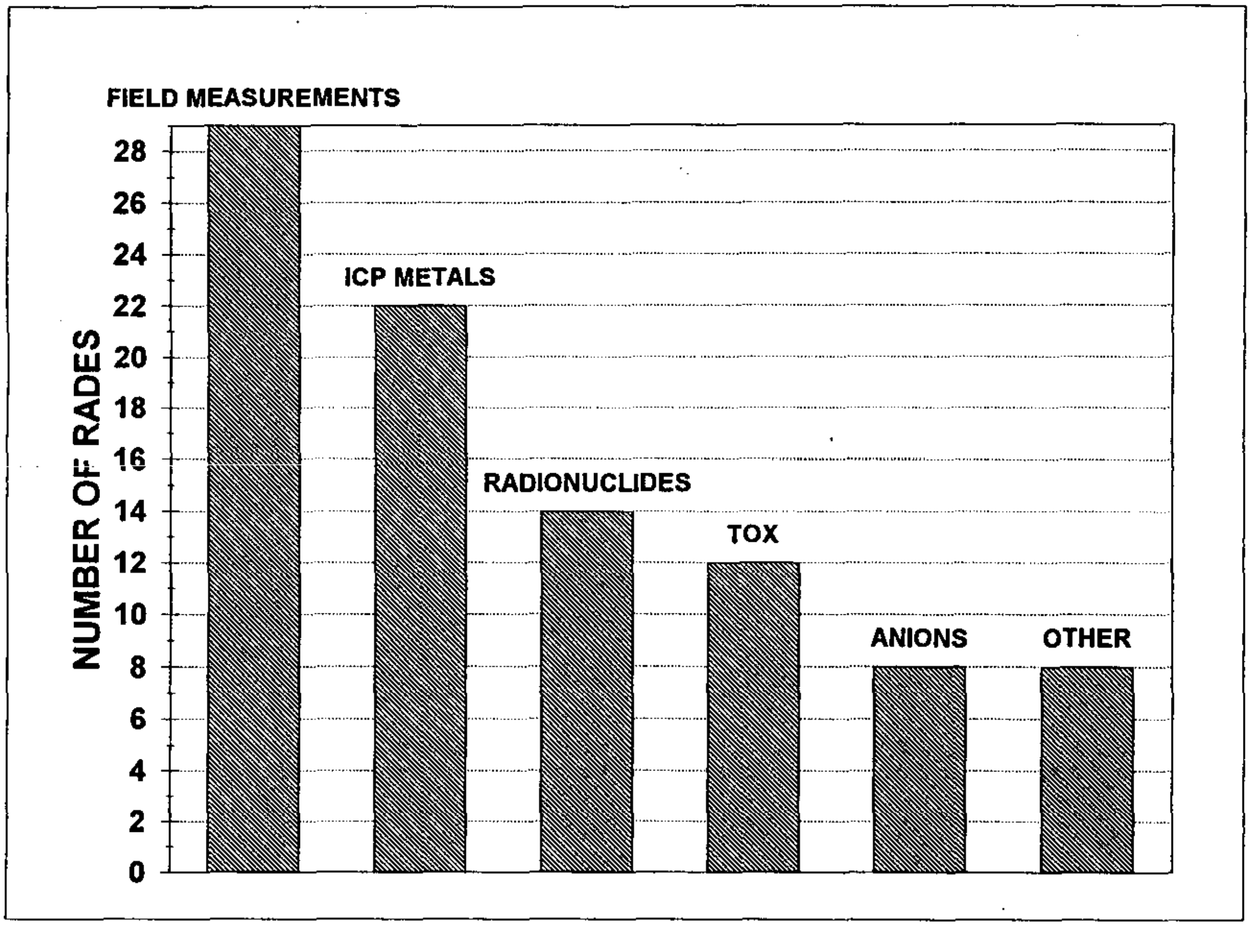
B.2.6 Others

The remainder of the categories reflect a variety of random problems, of which none could be contrived as significant enough to warrant review of established sampling and analysis practices. Examples in this category include total organic carbon, volatile organics, turbidity, and ammonium.

B.3 REFERENCES

WHC-CM-7-8, "Evaluation of Requests for Analytical Data Review," Section 4.2, *Environmental Engineering and Geotechnology Function Procedures*, Westinghouse Hanford Company, Richland, Washington.

Figure B-1. Histogram Showing Number of RADEs Submitted in Different Analytical Categories.



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APPENDIX C

STATISTICS

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C.0 INTRODUCTION

C. J. Chou
Westinghouse Hanford Company

The *Resource Conservation and Recovery Act of 1976* (RCRA) facilities include both liquid and solid waste treatment, storage, and/or disposal (TSD) units. Those units with potential for contaminating groundwater require groundwater monitoring as prescribed in 40 *Code of Federal Regulation* (CFR) 265 and *Washington Administrative Code* (WAC) 173-303-400 (interim status) and 40 CFR 264 and WAC 173-303-645 (final status). The primary objectives of RCRA groundwater monitoring are to: (1) comply with applicable interim and final status state and federal RCRA regulations and (2) assess potential impact on groundwater quality. Statistical evaluation at a TSD facility is required to detect changes in downgradient groundwater quality from conditions upgradient of the facility.

The final Hanford Facility RCRA Permit (RCRA Permit) was issued by the Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA) on August 29, 1994. The RCRA Permit became effective on September 28, 1994. The permit has two parts. The first part contains the requirements for operating the RCRA facility and standards for managing it under the base RCRA program (Ecology 1994). The second part contains the requirements for corrective action conditions for the cleanup of hazardous waste under the *Hazardous and Solid Waste Amendments to RCRA* (EPA 1994). Groundwater monitoring activities at most of the TSD units will continue to be governed under interim-status regulations except for the 183-H Solar Evaporation Basins, which are subject to final status regulations. Statistical evaluations under interim- and final-status regulations are discussed separately in the following sections.

C.1 STATISTICAL EVALUATIONS--INTERIM STATUS

In accordance with interim-status regulations, the RCRA projects are conducted under one of three levels of monitoring efforts: (1) background monitoring, (2) indicator parameter evaluation, and (3) groundwater quality assessment. Most of the RCRA facilities at the Hanford Site have completed their initial background monitoring programs.

Statistical evaluations for interim-status facilities during the past year consisted of: (1) re-establishing background levels for the single-shell tanks Waste Management Area U to reflect changes in the groundwater flow direction, (2) continuing evaluation of RCRA facilities' impact on the quality of groundwater, and (3) required statistical evaluations for the Solid Waste Landfill (SWL). The following sections provide a general description of the statistical method and results of statistical evaluations for the interim-status RCRA facilities. The SWL is a solid waste disposal facility. It is not a RCRA site. The current operations of the SWL fall under the regulations of WAC 173-304, and a permit application for the facility under this regulation has been prepared (DOE-RL 1993). The statistical method and results of statistical evaluations for the SWL are described in the SWL chapter of this report.

C.1.1 Statistical Method

The statistical method used to summarize background data is the averaged replicate t-test method as described in Appendix B of the *Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document (TEGD)* (EPA 1986) and Chou (1991). The averaged replicate t-test method, for each contamination indicator parameter, is calculated as:

$$t = (\bar{x}_i - \bar{x}_b)/S_b * \sqrt{1+1/n_b} \tag{1}$$

where:

t = Test statistic
$\bar{x}_i$ = Average of replicates from the i^{th} monitoring well
$\bar{x}_b$ = Background average
S_b = Background standard deviation
n_b = Number of background replicate averages.

The Technical Enforcement Guidance Document states that a test statistic larger than the Bonferroni critical value (t_c), i.e., $t > t_c$ indicates a statistically significant probability of contamination. These Bonferroni critical values depend on the overall false-positive rate required for each sampling period (i.e., 1% for interim status), the total number of wells in the monitoring network, and the number of degrees of freedom (n_b - 1) associated with the background standard deviation. Because of the nature of the test statistic in the above equation, results to be compared to background do not contribute to the estimate of the variance. The test can be reformulated, without prior knowledge of the results of the sample to be compared to background (i.e., $\bar{x}_i$), in such a way that a critical mean (CM) can be obtained:

$$CM = \bar{x}_b + t_c * S_b * \sqrt{(1+1/n_b)} \quad \text{(one-tailed).} \tag{2}$$

$$CM = \bar{x}_b \pm t_c * S_b * \sqrt{(1+1/n_b)} \quad \text{(two-tailed).} \tag{3}$$

For pH, a two-tailed CM (or critical range) is calculated and a one-tailed CM is calculated for specific conductance, total organic carbon (TOC), and total organic halogen (TOX). The CM (or range, for pH) is the value above which (or above/below in the case of pH), a compared value is determined to be statistically different from background.

Most of the measured values for TOC from upgradient (background) wells, were less than the contractually required quantitation limit (CRQL) of 1,000 ppb for DataChem Laboratories. Estimates of the background standard deviations cannot be obtained because of laboratory reporting practices. Also, a new hazardous chemical laboratory contract became effective during 1993. In the old contract (before April 26, 1993), these values were reported with the CRQL value followed by a 'U' qualifier. In the new contract (after April 26, 1993) results below CRQL but above the method detection limit (MDL) are reported with the measured value followed by an 'L' qualifier. Results below the MDL are reported with the MDL value followed by a 'U' qualifier. The lack of estimates of background variability precludes the determination of TOC critical means for various RCRA facilities. In this case, a limit of quantitation (LOQ) will be used as the upgradient/downgradient comparison value. The LOQ for TOC was calculated to be 1,252 ppb using 1994 field blanks data (see Appendix A).

Because of concerns over DataChem Laboratories' procedure for TOX, samples have been analyzed by Roy F. Weston Laboratories since November 1993. The change of laboratories does not provide the needed background values from which critical means are derived. However, the TOX data (analyzed during the past year) can be evaluated using the following steps: (1) screening TOX values from upgradient wells; (2) if results from upgradient wells indicate a history of non-detects, a LOQ will be used as the upgradient/downgradient comparison value; and (3) if TOX is historically detected, a LOQ cannot be used as a surrogate background value. In this case, the background value must be derived based on four quarters of monitoring data; comparisons of upgradient/downgradient TOX data will not be performed.

Finally, if the calculated critical range (for pH) was outside the chemically possible range [0, 14] or too large to be meaningful because of the requirement to use four quarters of data to establish background (e.g., 2101-M Pond, Liquid Effluent Retention Facility), the upgradient/downgradient comparison value shall be the revised critical range using all available data. The expansion of the background data set to include more than 1 year's data provides a better estimate of background mean and background standard deviation. More importantly, it increases the number of degrees of freedom associated with the background standard deviation. Other things being equal, a smaller t_c value and a narrower critical range for pH would result. This approach is preferred because it complies with both the requirements and the spirit of regulations.

C.1.2 Results of Statistical Evaluations

During the past year, the TOX critical mean (established by using background samples analyzed by U.S. Testing Inc.) for the 2101-M Pond was exceeded in one of the downgradient wells, 299-E18-4, during the December 1993 sampling event. The well was resampled and samples were sent to two laboratories for analyses. However, results obtained from the two laboratories were inconclusive. The analytical result from one laboratory was a nondetect. The split sample analyzed by another laboratory was detected at 18.4 ppb. In addition, the required quadruplicate samples were not collected. Another round of verification sampling was initiated and analytical results are not available.

Field pH averages from two downgradient wells at Low-Level Waste Management Area 2 (299-E27-8 on 11/10/93 and 299-E34-12 on 11/15/93), one downgradient well at the S-10 facility (299-W26-10 on 6/21/94), and one downgradient well at the 216-B-63 Trench (299-E27-8 on 11/10/93) were outside the lower critical ranges. Results of verification sampling confirmed that the initial field pH measurements were in error.

There have been other pH exceedances in the upgradient wells of several RCRA facilities (199-D5-13 on 6/8/94 at 100-D Pond and 299-W6-2 on 8/19/94 at Low-Level Waste Management Area 5) during the past year. Field pH measurements were below the respective lower critical limits. Verification sampling results for the 100-D Pond confirmed that the initial field pH measurements were in error. Resampling of well 299-W6-2 was also initiated; however, results are not available yet. There is no exceedance of CMs in other RCRA facilities. Detailed statistical evaluations can be found in sections of this report designated for each RCRA facility.

C.2 STATISTICAL EVALUATIONS--FINAL STATUS

Three levels of groundwater monitoring programs are required under final status regulations (40 CFR 264, Subpart F and WAC 173-303-645): detection monitoring, compliance monitoring, and corrective action (Figure C-1). During the past year, however, groundwater monitoring activities conducted at RCRA projects were monitored under interim-status requirements.

C.2.1 Detection-Level Groundwater Monitoring Program

In a detection-level groundwater monitoring program, groundwater parameter data (pH, specific conductance, TOC, TOX, or heavy metals, waste constituents, or reaction products) from downgradient compliance point wells will be compared with area background wells data semiannually to determine whether there is a statistically significant increase (or decrease for pH) over background concentrations. Statistical methods appropriate for a final status detection monitoring program will include analysis of variance, tolerance intervals, prediction intervals, control charts, test of proportions, or other statistical methods approved by Ecology. The distribution(s) of monitoring parameters, the nature of the data, the proportions of nondetects, seasonal, temporal, and spatial variations are important factors to consider when selecting appropriate statistical methods. The statistical evaluation procedures chosen will be based on the EPA guidance documents: *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance* (EPA 1989) and *Addendum to Interim Final Guidance* (EPA 1992). Specifics will be addressed in the unit-specific permit applications.

C.2.2 Compliance-Level Monitoring Program

A compliance groundwater monitoring program will be established for a TSD unit if groundwater sampling during the detection-level monitoring program reveals a statistically significant increase (or pH decrease) over area background concentrations for groundwater. In a compliance-level monitoring program, the monitoring objective is to determine whether groundwater protection standards have been exceeded. This is accomplished by comparing the concentration of a constituent of concern to groundwater protection standards such as a risk-based maximum concentration limit; alternative concentration limit; area or natural background; or applicable, relevant, and appropriate requirements.

Maximum concentration limits will be identified for each groundwater monitoring parameter listed in Table 1 of WAC 173-303-645. Alternative concentration limits will be proposed after considering the observed concentrations of chemical constituents in the groundwater that might have originated from the regulated unit in question. The area background, natural background, and other standards that are applicable, relevant, and appropriate requirements will be evaluated when proposing an alternative concentration limit.

C.2.3 Corrective-Action Program

If, during compliance-level monitoring, the referenced concentration limit(s) for a given groundwater parameter or parameters are significantly exceeded, a corrective-action program will be developed and implemented to protect human health and the environment. Details for the corrective action program will be specified in the unit-specific permit applications. In addition, a groundwater monitoring plan that will be used to assess the effectiveness of the corrective-action measures will be submitted. This monitoring plan will be similar in scope to the compliance-level groundwater monitoring program and will include all relevant information pertaining to the location and description of monitoring wells, monitoring network, well construction and development, sampling and analysis plans, statistical methods, and quality assurance and quality control procedures.

C.2.4 183-H Solar Evaporation Basins (183-H)

As described above, the RCRA Permit became effective on 9/28/94. The 183-H Solar Evaporation Basins (183-H Basins) are one of five TSD units included in the RCRA Permit and are subject to final-status groundwater monitoring regulations. This unit will be closed under final-status requirements (WAC 173-303-610).

Groundwater monitoring at 183-H Basins was mandated by a *Consent Agreement and Compliance Order* (Ecology and EPA 1986). It went into an interim-status assessment-level monitoring program directly in response to the 1986 *Consent Agreement and Compliance Order*. The groundwater monitoring plan was prepared by Pacific Northwest Laboratory based on interim-status regulations using limited data from then-existing 100-H Area wells (PNL 1986). In 1990 a closure plan was prepared (DOE-RL 1991). However, groundwater monitoring described in these documents does not address whether 183-H Basins should be under compliance monitoring (equivalent to the interim-status assessment monitoring) or corrective action (because some concentration limits have been exceeded). Furthermore, the current groundwater monitoring plan must be revised to reflect final status requirements, and to describe the updated well list, constituent list, and sampling frequency. Finally, 183-H Basins are currently managed by WHC for Bechtel Hanford, Inc. (BHI), the permittee. Inputs from BHI are needed for revising the groundwater monitoring plan. Efforts are currently underway to address groundwater monitoring requirements and corrective action, if necessary.

C.3 BACKGROUND TABLES

This section contains revised background information for single-shell tank Waste Management Area U because the change in the groundwater flow direction warrants the re-establishment of background conditions. Three tables are provided: (1) Table C-1 lists input data for background well(s); (2) Table C-2 contains background replicate averages; and (3) Table C-3 presents the background summary statistics.

C.4 REFERENCES

Chou, C. J., 1991, *Statistical Approach on RCRA Groundwater Monitoring Projects at the Hanford Site*, WHC-SA-1124-FP, Westinghouse Hanford Company, Richland, Washington.

DOE-RL, 1991, *183-H Solar Evaporation Basins Closure/Postclosure Plan*, DOE/RL 88-04, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993, *Hanford Site Solid Waste Landfill Permit Application*, DOE/RL-90-38, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology and EPA, 1986, *Consent Agreement and Compliance Order*, Ecology No. DE 86-133, Washington State Department of Ecology and the U.S. Environmental Protection Agency, Olympia, Washington.

Ecology, 1994, *Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, Permit Number WA7890008967, Washington State Department of Ecology, Olympia, Washington.

EPA, 1986, *Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document (TEGD)*, OWSER-9950.1, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1994, *Hazardous and Solid Waste Amendments Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Hazardous Waste*, Permit Number WA7890008967, U.S. Environmental Protection Agency, Washington, D.C.

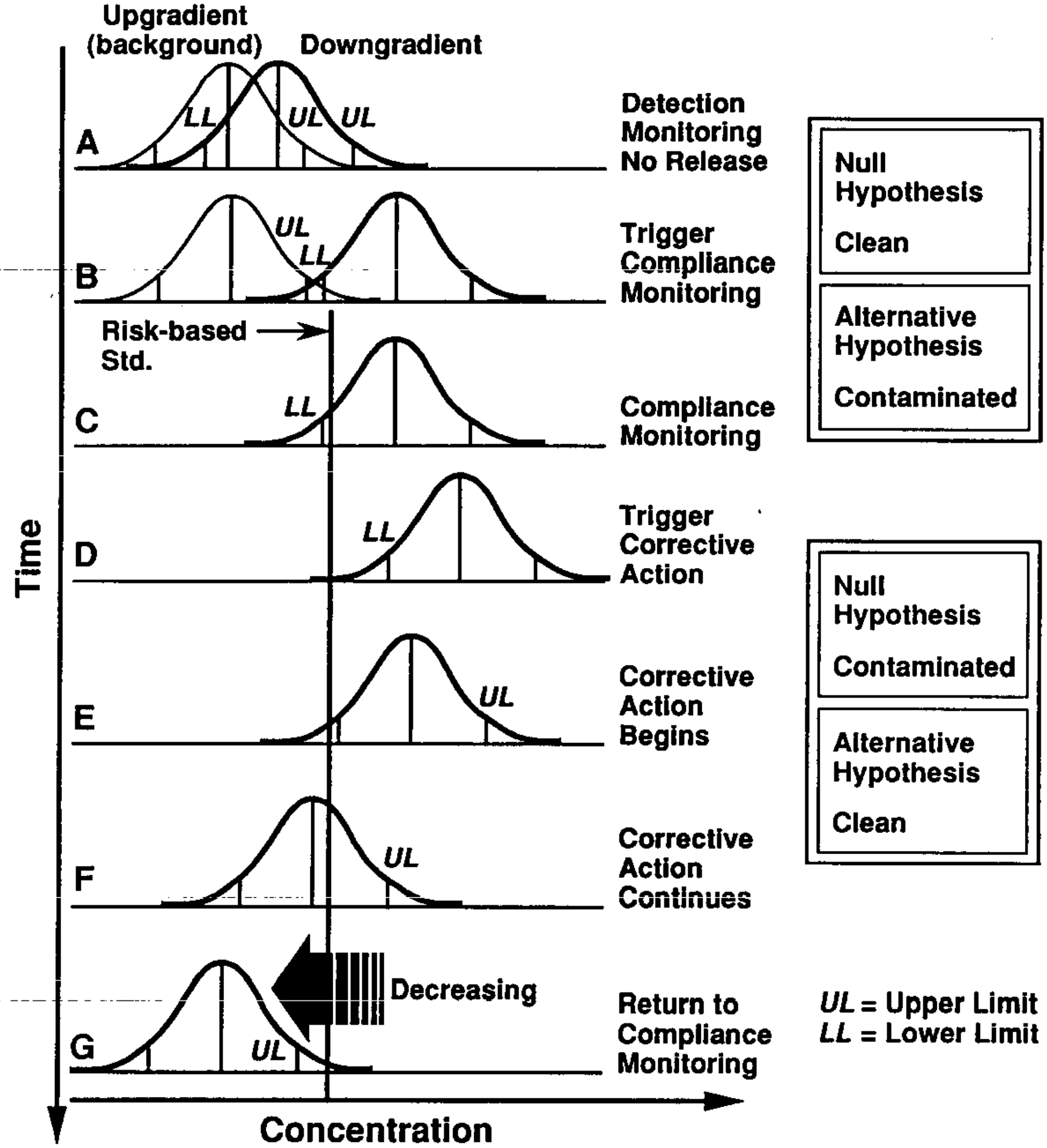
PNL, 1986, *Revised Ground-Water Monitoring Compliance Plan for the 183-H Solar Evaporation Basins*, PNL-6470, Pacific Northwest Laboratory, Richland, Washington.

Resource Conservation and Recovery Act of 1976, 42 USC 6901 et seq.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-304, "Minimum Functional Standards for Solid Waste Handling," *Washington Administrative Code*, as amended.

Figure C-1. A Statistical Perspective of the Sequence of Groundwater Monitoring Requirements Under RCRA.



(Notice that until contamination above a risk standard is documented (D) the null hypothesis is that the facility is clean. Once the facility has been proven to be in exceedance of a health criteria then the null hypothesis is that the facility is contaminated until proven otherwise (G).

H9401016.1

Table C-1. Background Contamination Indicator Parameter Data for the Single-Shell Tanks Waste Management Area U. (page 1 of 2)

Well name	Sample date	Dupl. sample number	Specific conductance μmho/cm 1/700w	Field pH 0.01/[6.5, 8.5s]	TOC ppb 1000/.	TOX[P] ppb 10/.
2-W19-31	04/21/92	1	356	8.00	1000[UH]	
		2	360	8.00	1000[UH]	
		3	358	7.99	1000[H]	
		4	360	7.98	1000[UH]	
2-W19-31	07/20/92	1	359	7.76	1000[U]	
		2	359	7.74	1000[U]	
		3	358	7.74	1000[U]	
		4	358	7.73	1000[U]	
2-W19-31	11/10/92	1	352	8.13	1000[U]	
		2	349	8.11	1000[U]	
		3	346	8.10	1000[U]	
		4	349	8.09	1000[U]	
2-W19-31	03/04/93	1	348	8.03	1000[U]	
		2	346	8.02	1000[U]	
		3	347	8.02	1000[U]	
		4	349	8.02	1000[U]	

The column headers consist of: Constituent Name; Analysis Units; and Contractually Required Quantitation Limit/Drinking Water Standard (suffix).

Suffix s = based on Secondary Maximum Contaminant Levels in 40 CFR Part 143, National Secondary Drinking Water Regulations

w = based on additional Secondary Maximum Contaminant Levels in WAC 248-54, Public Water Supplies

Data flag:

[U]denotes that analyte concentration is below CRQL. Reported values were analytical laboratories' CRQL.

[P]denotes problem associated with data quality. Values are not reported.

[H]denotes laboratory holding time is exceeded.

Table C-1. Background Contamination Indicator Parameter Data for the Single-Shell Tanks Waste Management Area U. (page 2 of 2)

Well name	Sample date	Dupl. sample number	Specific conductance µmho/cm 1/700w	Field pH 0.01/[6.5, 8.5s]	TOC ppb 1000/.	TOX[P] ppb 10/.
2-W19-32	04/22/92	1	318	8.10	1000[U]	
		2	319	8.11	1000[U]	
		3	318	8.11	1000[U]	
		4	317	8.12	1000[U]	
2-W19-32	07/20/92	1	280	7.74	1000[U]	
		2	278	7.77	1000[U]	
		3	279	7.80	1000[U]	
		4	277	7.81	1000[U]	
2-W19-32	11/13/92	1	355	8.27	1000[U]	
		2	357	8.28	1000[U]	
		3	353	8.27	1000[U]	
		4	347	8.27	1000[U]	
2-W19-32	03/05/93	1	324	8.29	1000[U]	
		2	325	8.29	1000[U]	
		3	324	8.29	1000[U]	
		4	324	8.29	1000[U]	

The column headers consist of: Constituent Name; Analysis Units; and Contractually Required Quantitation Limit/Drinking Water Standard (suffix).

Suffix s = based on Secondary Maximum Contaminant Levels in 40 CFR Part 143, National Secondary Drinking Water Regulations
w = based on additional Secondary Maximum Contaminant Levels in WAC 248-54, Public Water Supplies

Data flag:

[U]denotes that analyte concentration is below CRQL. Reported values were analytical laboratories' CRQL.

[P]denotes problem associated with data quality. Values are not reported.

Table C-2. Average Replicate Statistics--Background Indicator Parameter Data for the Single-Shell Tanks Waste Management Area U. (page 1 of 2)

Constituent (unit)	Well name	Sample date	n	Average	Standard deviation	C.V. (%)
Specific conductance (μmho/cm)	2-W19-31	04/21/92	4	358.50	1.915	0.53
	2-W19-31	07/20/92	4	358.50	0.577	0.16
	2-W19-31	11/10/92	4	349.00	2.450	0.70
	2-W19-31	03/04/93	4	347.50	1.291	0.37
Field pH	2-W19-31	04/21/92	4	7.992	0.010	0.12
	2-W19-31	07/20/92	4	7.742	0.013	0.16
	2-W19-31	11/10/92	4	8.108	0.017	0.21
	2-W19-31	03/04/93	4	8.022	0.005	0.06
TOC[a] (ppb)	2-W19-31	04/21/92[H]	4	N.C.	N.C.	N.C.
	2-W19-31	07/20/92	4	500[U]	N.A.	N.A.
	2-W19-31	11/10/92	4	500[U]	N.A.	N.A.
	2-W19-31	03/04/93	4	500[U]	N.A.	N.A.
TOX (ppb)	2-W19-31	04/21/92[P]	4	N.C.	N.C.	N.C.
	2-W19-31	07/20/92[P]	4	N.C.	N.C.	N.C.
	2-W19-31	11/10/92[P]	4	N.C.	N.C.	N.C.
	2-W19-31	03/04/93[P]	4	N.C.	N.C.	N.C.

Note: Summary statistics calculated from only those samples that had four replicate values.

[a]statistics were calculated by replacing not detected values with half of the respective CRQL.

[U]denotes calculated values are below the CRQL.

[H]denotes replicate average is not calculated due to exceedance of laboratory holding time and a laboratory nonconformance report was issued.

[P]replicate averages are not calculated due to problems related with data quality for samples analyzed by DCL.

N.A. = not available. C.V. = coefficient of variation.
N.C. = not calculated.

Table C-2. Average Replicate Statistics--Background Indicator Parameter Data for the Single-Shell Tanks Waste Management Area U. (page 2 of 2)

Constituent (unit)	Well name	Sample date	n	Average	Standard deviation	C.V. (%)
Specific conductance (μmho/cm)	2-W19-32	04/22/92	4	318.00	0.816	0.26
	2-W19-32	07/20/92	4	278.50	1.291	0.46
	2-W19-32	11/13/92	4	353.00	4.320	1.22
	2-W19-32	03/05/93	4	324.25	0.500	0.15
Field pH	2-W19-32	04/22/92	4	8.110	0.820	0.10
	2-W19-32	07/20/92	4	7.780	0.032	0.41
	2-W19-32	11/13/92	4	8.272	0.005	0.06
	2-W19-32	03/05/93	4	8.290	0	0
TOC[a] (ppb)	2-W19-32	04/22/92	4	500[U]	N.A.	N.A.
	2-W19-32	07/20/92	4	500[U]	N.A.	N.A.
	2-W19-32	11/13/92	4	500[U]	N.A.	N.A.
	2-W19-32	03/05/93	4	500[U]	N.A.	N.A.
TOX (ppb)	2-W19-32	04/22/92[P]	4	N.C.	N.C.	N.C.
	2-W19-32	07/20/92[P]	4	N.C.	N.C.	N.C.
	2-W19-32	11/13/92[P]	4	N.C.	N.C.	N.C.
	2-W19-32	03/05/93[P]	4	N.C.	N.C.	N.C.

Note: Summary statistics calculated from only those samples that had four replicate values.

[a]statistics were calculated by replacing not detected values with half of the respective CRQL.

[U]denotes calculated values are below the CRQL.

[P]replicate averages are not calculated due to problems related with data quality for samples analyzed by DCL.

N.A. = not available. C.V. = coefficient of variation.
N.C. = not calculated.

Table C-3. Background Statistics[a]--Contamination Indicator Parameter Data for the Single-Shell Tanks Waste Management Area U.

Constituent	Units	n	Background average	Background standard deviation	Background C.V. (%)
Specific conductance	μmho/cm	8	335.906	27.700	8.25
Field pH		8	8.040	0.202	2.51
TOC	ppb	7*	500	N.C.	N.C.
TOX[b]	ppb	N.C.	N.C.	N.C.	N.C.

Note: Summary statistics calculated from only those samples that had replicate values.

[a]Background summary statistics for TOC were calculated using values below CRQL.

[b]Background summary statistics for TOX are not calculated due to problems related to data quality.

*Excluding TOC results from samples collected on 4/21/92 from well 2-W19-31 due to exceedance of laboratory holding time and a laboratory nonconformance report was issued.

N.C. = not calculated.

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